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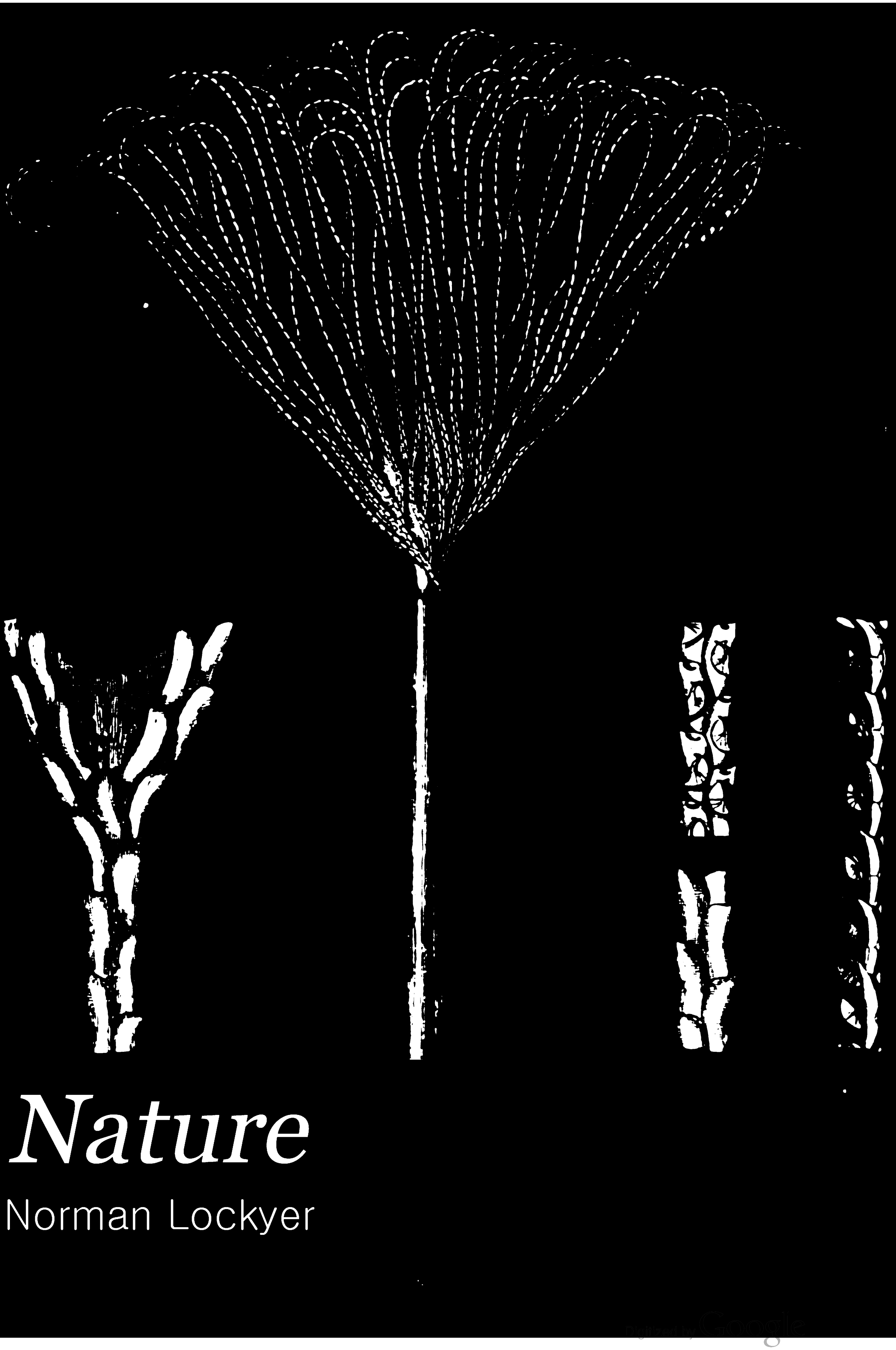

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Norman Lockyer

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O Nature trusts the mind that builds for aye."—WORDSWORTH

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NATURE

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" *To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

THURSDAY, NOVEMBER 7, 1872

THE LAST ERUPTION OF VESUVIUS

THE scientific results of the late eruption of Vesuvius promise to be as important to science as the phenomena were grand and awe-inspiring to the spectator. Not only has Prof. Palmieri published an account of the observations from his dangerous standpoint, in Italian and German, which will shortly make its appearance here in the English translation by Mr. Mallet, but M. Henri Saussure has also published in the Geneva *Bibliothèque Universelle* an account of an excursion made by him to Vesuvius about the middle of last May, shortly after the violent eruption of April. This account, given by such a competent observer, is so interesting and valuable, from all points of view, that it must be regarded as a most valuable addition to the literature of one of the most popularly-known volcanoes on our planet. For the better understanding of the geographical features we may refer our readers to the article in NATURE, vol. vi. p. 2.

Vesuvius, as Prof. Phillips has taught us, was formerly a mountain forming a vast circle, whose central part, occupied partly by a crater—which, without doubt, has been often displaced within the limits of the circumference—was not less than three kilometres in diameter, and the projecting part of which, occupied at present by the cone, formed then only a kind of plateau. The famous eruption of A.D. 79, which happened unexpectedly after a very long period of repose, entirely changed the form of the mountain. Very little lava seems to have been given forth during that eruption, which was characterised by tremendous showers of stones and ashes, and by rivers of mud. This it was that buried Pompeii and Herculaneum, the former being covered by fifteen feet, the latter by thirty or forty feet of *débris*, and which, at the same time, appears to have formed, by accumulation, the present mountain of Vesuvius, placed in the centre of the ancient circle, the work having been completed by innumerable successive eruptions.

The Vesuvius group, then, is at present composed of two distinct mountains—namely, the cone of Vesuvius, and the rest of the ancient circle which form, to the north and west, a vast amphitheatre, named *La Somma*. Between the two mountains is an elevated horse-shoe shaped valley, the middle part of which bears the name of *Atrio del Cavallo*, and the upper extremity, towards the east, that of *Canale del Inferno*. This elevated valley is depressed and widened towards the west, where it takes the name of *Gli Atri*, and ends by being lost upon the slopes of the *Piano* which form the buttresses of the two mountains, and which emerge by various ravines into the plains which stretch from San Sebastiano to Torre del Greco.

This description would be incomplete if we did not mention a knoll or hillock, apparently insignificant, but in reality of great importance from the part it plays in giving direction to the lava. This little eminence, named Monte de Canteroni, has the form of an elongated saddleback; it runs east and west, parallel with the western extremity of the crest of La Somma, rising towards Vesuvius. It divides, as it were, in the direction of its length, the outlet of the elevated valley, and as it does not reach the foot of the cone of Vesuvius, it forms only an incomplete partition which divides the currents of lava flowing out of Atrio del Cavallo. At the lower or western extremity of this saddleback is situated the Observatory.

The greatest overflows are always those which make their way across the mass of the mountain; for when a volcano has acquired a certain height, the weight of the liquid column which issues from the vent becomes so considerable that the incandescent matter must rush from the fissures at a lower level. But, for a certain number of years, the centre of eruption of lava seems to have shifted towards Atrio del Cavallo, in the elevated valley situated between the two mountains.

In 1855 and the following years, eruptions made their way or had been thrown upon this point, and have transformed the elevated valley into a sort of sea of lava, which at present may be about 1,000 metres in breadth. The burning torrent makes its way to the west, but on leaving the valley of Atrio, it very soon encounters Monte de Canteroni, which divides the current into two unequal parts, giving to each a different direction, throwing back the principal stream on the left into Fosso Vetrana, and the small part on the right, upon the slopes of the Piano. The lava does not scoop out but only rolls along the ground, the eroded ravines which furrow the sides of the mountain becoming necessarily their natural channels. Thus the successive currents have followed very nearly the same channel, being superimposed on each other through a great part of their course. When the lava streams are of considerable depth, they often pass over small inequalities of ground, and leap to right and left when they strike against any considerable obstacle.

A good carriage road leads from Resina as far as the Observatory, across the cultivated slopes which are covered with houses. At less than a kilometre from the Observatory, the road traverses the lava of 1858, which has covered up the old route, and through which it has become necessary to reopen the way. Almost immediately after having passed the lava, the Observatory is reached, where Prof. Palmieri sojourned during the terrible days of the last eruption. This building, situated at a height of 600 metres, is a substantial freestone structure of two stories, surrounded by beautiful terraces which overlook the lava field on all sides, and the edges of which are enclosed by a handsome railing not much in keeping with the desolate aspect of the place. M. Palmieri has been compelled, from the want of trained assistants, to set up registering apparatus, and can obtain certain connected observations only during the time of his occasional stay at the Observatory. But for this circumstance, the last eruption would probably have been foreseen for some time.*

From the Observatory, the summit of Mount Vesuvius can be reached in two hours. The road skirts the immense fields of black lava which stretch between Monte Canteroni and the foot of Vesuvius, and which have been formed by the recent eruptions as they escaped from Atrio del Cavallo. The lava of April 26 M. de Saussure found already quite cooled on the surface. There would not appear to be a greater amount of incandescence at the bottom of any crevasse, although the matter certainly preserves its heat under the superficial stratum, as was attested by the great number of fumaroles encountered almost everywhere. These emanations escaped for the most part from little kilns, or swollen crevasses, which communicate by clefts with the deeper lava. Around some of these fires there prevailed a strong odour of hydrochloric acid, while other vents did not emit anything but steam or warm air. These are, indeed, the successive phases which mark these emanations of lava until they reach complete coolness.

At first, the whole surface of the lava-streams seems to exhale steam and hydrochloric acid, and the atmosphere is filled with a disagreeable odour which makes breathing uncomfortable. But very quickly the exhalations are localised around the little centres of fire, whose activity continues for many months, and emanations from which are gradually modified. Thus, as seen from Naples at the time of the visit, the whole of the lava appeared to be smoking, and it was possible clearly to distinguish the tracks of the whitish vapours which appeared to wander over the surface; but close at hand there was nothing to be seen but the fumaroles, between each of which there is plenty of space. The gas and the hot vapours which the lava emits are charged with numerous substances, and become the source of mineral deposits which fill the tourist with wonder. One of the most curious phenomena observed is the power of burning lava to retain an enormous quantity of water and salt, which it does not allow to escape until it begins to cool. The formation of salt is shown generally over the whole stretch of lava emitted in 1872. Soon after the surface cools it is covered with a light crust of salt, which forms in similar flowery patterns on the beds of cinders that cover the plains, the cinders themselves emitting everywhere hydrochloric acid. The first showers caused this deposit rapidly to disappear, and there remained on the 12th of May only scanty traces, except on the lower surface of the blocks, where the rain had not the power to dissolve it. But the salt continued to be deposited in the vents, from which were detached beautiful crystals and graceful concretions; it continued also to be formed upon the great deposits of cinders on the cone of Vesuvius, and, even on May 19, the summit of the mountain, as seen from the Observatory, appeared from this cause as if sprinkled with snow.

Next to salt, the substance which is formed in greatest abundance upon the lava is chloride of iron, which assumes the most varied tints according to its surroundings, but is in general of a beautiful yellow, often orange, and is easily mistaken for sulphur. A multitude of other substances are deposited around the smoke-vents, besides those which have been named. These are for the most part metallic compounds, especially chlorides, and more rarely sulphur compounds. There are chlorides of copper and lead, hæmatite and magnetic iron ore, gypsum, &c. The peroxide of iron, in particular, plays an important part in the life of these fumaroles; it appears to be formed by the decomposition of chloride of iron; the protuberances of the scoriæ are often covered with the substance, which gives them the richest and most brilliant variegated appearance.

The origin of these many substances has considerably occupied the attention of chemists, and has not yet been satisfactorily explained; but the form of the concretions, as much as the accumulation of substance, apparently foreign to lava, indicate that they are formed by sublimation.

When the summit of the cone was approached, fine ashes were found scattered about the transverse rents that are apt to be taken for ruptures caused by the concussions accompanying the eruptions. But violent fissures would rather have formed radiating or longitudinal rents, while these are perhaps only the effect of the settlement of the cinders which naturally tend to act in the direction of the greatest slope, and to give rise to fissures analogous to those which are observed in the centre of the Alps. It is to this same phenomenon that must be attributed the step-like structure, traces of which are met with on the external face of the summit of the mountain, and which is probably owing to the fact that the lower edge of the rents must be elevated by the settlement, while the upper edge remains unaffected, or is itself lowered in supplying the matter which afterwards fills the rents. On the outside face of the cone, these steps are scarcely more than three or four inches in height, but on the margin of the internal face of the south-west side of the crater are four large sharp-edged steps of more than a metre high, arranged stair-wise, the formation of which can scarcely be explained otherwise than by a deposit or a flow of ashes accumulated at the end of the last eruption.

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* See description of the Observatory, NATURE, vol. vi. p. 145.

A vast transverse funnel, much larger than it is broad, occupies the south-west part of the summit of the cone, and this gulf is itself divided at the bottom by a partition of rocks which divides it into two compartments. A third crater occupies the north part, and is separated from the first by a considerable wall of rocks. This latter crater opens into the great north fissure which descends into Atrio del Cavallo; it was opened during the last eruption at the expense of an adventitious cone raised in 1855, and appears to have been the most active, since it is upon its side that the mountain is rent as far as the base of the cone; however, it has not ejected any lava, this having found its way out by the bottom of the fissure. During the eruption the lava was raised as far as the summit of the mountain—it has filled to the brim the double crater on the south-west—yet two days after this the lava had escaped by the south side; for on the 24th of April it overflowed the crater and formed three streams on the south, the west, and the north-east, which flowed down the slopes of the cone, and lost themselves among the fields of lava underneath. After this event the lava fell back to the bottom of the craters.

The depth of the crater may be estimated at about 130 metres. The bottom appears to be full of *débris* and ashes, but shows no sign of incandescence, nor of any adventitious cone; no smoke ascends, and the volcano, after its convulsion, has apparently fallen into a complete sleep. The only signs of activity are seen in the numerous unimportant jets of white vapour which escape either from the bottom or from various points in the walls, and which appear to dissolve in the atmosphere. Nevertheless, as seen from Naples, Vesuvius always appears with a light smoke hanging over it, which is invisible on the mountain itself. On the side next Pompeii only, to the east and north-east the slopes are macadamised by bomb-like blocks of the size of the head. The crater must have projected from all sides a shower of such blocks, but over all the other parts of the mountain this deposit must have been covered by a thick bed of ashes; and since these blocks are seen only on the east, it is evident that at the time of the last eruption of cinders a violent wind must have blown them to the opposite side. The large blocks, if they have been thrown up to the height of 1,500 metres, appear to have fallen back at a short distance from the crater. Shot vertically, they fell so, while the ashes, on account of their greater lightness, have been carried to a greater distance.

The crater on the south-west is divided through and through by a narrow rent, which is doubtless the prolongation of that which on the 24th emitted, half way up, the lava which went in the direction of Torre del Greco. This rent divides the south crest, and may be traced upon the walls of the crater, where it looks only like a simple fissure; it re-appears more distinctly on the opposite side. Another disappears among the cracks of the rocks. This rent exhaled at the summit of the crater burning gases, which formed upon the sides abundant deposits. The south crest was sufficiently filled up by sand to enable one to cross it, but such a quantity of sulphurous vapours was emitted, that to escape being asphyxiated it was necessary to make several rapid leaps. On the west side of the crater the rent still gapes, and has not been filled up, notwithstanding the heat which escaped.

The eruption of April 26 which followed the rending of Vesuvius, reopening the same vent, suddenly made its way to the same point, shattering the manifold bed of lava, and ejecting to the surface immense blocks, probably torn from their beds far below. Of this *débris*, mixed with incandescent lava, there is formed an elongated ridge of about 50 metres high, from the base of which there sprung an enormous mass of lava that swept over the little cone of Atrio. The lava burst forth at first in all directions, even a little behind in ascending the valley. It filled all Atrio, without, however, encrusting anywhere the sides of the rocks of the Amphitheatre of La Somma, and flowed along the valley in the form of a current of about 1,000 metres broad. Subsequently encountering the ridge of Canteroni, it was turned to the right, though a part of it was separated by the upper extremity of this knoll, and diverted to the left on to the slopes of Piano, where it contorted somewhat the foot of the mountain, thanks to the lava of 1858, which, having changed the slope of the ground, prevented it from continuing its route. The principal stream continued to follow the valley of the Fosso de la Ventrana, running at the rate of about one kilometre and a half in two hours, passing under the Observatory, where the lava was seen to boil up at places and shoot forth into little eruptions, projecting jets of steam and scoriæ; then it was precipitated in a cascade of fire over a wall of rock, and continued its course by the same ravine as the stream of 1855, and for the greater part of its course overrunning the lava of that year. It passed, exactly as its predecessor did, between the villages of Massa and San Sebastiano, sweeping away likewise a portion of the houses, part of it at last lodging itself on the south of Cercola, while a branch of the current continued in the direction of San Giorgio.

The imagination is unable to comprehend how such a mass of matter could escape in a single day from a single fire, and spread itself over an area of seven kilometres. The elongated ridge formed in the Atrio, at the time of the eruption, upon the site of the centre of the outbreak, appears at present only like a huge bubble on the sea of lava. It is composed of recent black lava, strewed with enormous blocks of old bleached lava encased in the new. These blocks are, without doubt, the *débris* of subjacent beds which have been broken and driven back by the lava at the time of its outbreak; the mass of them encrusted with the same lava having formed a whole so solid that it could not be swept away by the general current. This ridge does not now overtop the surface of the lava more than fifteen to twenty metres, from which we may conclude that the bed of lava at this point has an enormous depth.

The general effects of the eruption of 1872 have been somewhat as follows, according to M. de Saussure:—

1. The mountain of Vesuvius has been divided by a rent running nearly from north to south-south-west.

2. The lava, rising in the rent, has rushed along the two sides, on the north to the very foot of the cone, on the south half-way down in much less abundance.

3. The summit of the mountain has been lowered and flattened.

An examination of the lava of 1872 does not appear likely to lead to any new results. Its mineralogical nature is essentially the same as that of the other lavas of all ages that have been found both on Vesuvius and in La Somma. It is composed of a leucitic rock strewn with crystals of augite, and destitute of vitreous felspar; whence the names of leucitiferous or augitiferous, as one or other substance prevails. The most ancient lava which forms the body and crevices of La Somma, is in general very pale; it often contains an abundance of leucite crystals of the size of a foot; but its composition is, qualitatively, essentially analogous to that of the actual black lava. The lava of 1872 differs considerably in its physical appearance from that of 1858. The last is much less scoriated; it has a fleecy surface formed of round embossments, shining and comparatively little roughened. We might liken it to black whipped cream, which has flowed along, forming arches, fibrous stalactites twisted cords, which look at places as if vitrified. The lava of 1872, on the contrary, is extremely scoriaceous, and assumes a form almost like madrepore. On account of the great shrinking of the material, it has been broken up into blocks, entirely separated from each other, and roundish, because the mass was as yet vitreous; porous, in consequence of the quantity of gas it enclosed, and full of the most curious irregularities resembling coral and vegetation, which render progress infinitely difficult. The difference of appearance, combined with a thin layer of gray cinders which adheres to the lava of 1872, enables one to distinguish at once between it and those of preceding years. It will be noticed also to the north of the Observatory that the current has filled all the bottom of the valley of Ventrana, while on the south it has only run into the crevices of the old lava, surrounding the knolls, separating, re-uniting, leaving here and there inlets, as rivers without any determinate bed do at low water. This difference of structure of the two lavas seems to result from the very rapid cooling of that of 1872.

It is not easy to form a notion of the depth of this lava. In the lower parts the bed is about eight metres deep, with a breadth of about 800 metres; its borders form moraines of 45°, which indicate the small fluidity of the matter at the time it reached the place. In Atrio del Cavallo the moraine of the bed of lava which leans against the foot of the rocks of La Somma is less elevated, but the enormous waves in the middle of this surface argue in some places a considerable thickness.

The successive eruptions which have taken place in Atrio and which have piled up layer on layer, have enormously raised the level of the ground. A German geologist has conceived the idea of counting the layers which form the vertical dykes on the rocks of La Somma. At present the number would be hidden beneath more than a hundred feet of lava. The stream which debouches from Atrio has ended by considerably overtopping the Observatory; and that the latter has not been threatened this year results from the fact that the saddleback of Monte Canteroni, upon which it stands, rises in the direction of Vesuvius in such a manner that its eastern extremity (Croce del Salvatore) has hitherto performed the part of a buttress in dividing the burning stream and diverting the two currents into the ravines which slope rapidly to the right and left of the height. But a new outbreak will, without doubt, sweep away the eastern extremity of this crest, and a succeeding one would easily be able to send a stream of lava flowing as far as the Observatory. Foreseeing this danger, M. Palmieri has raised above the building a redan of a very sharp angle. This will form but a weak barrier, though it may be able to retard for a little the progress of the devastating element. Since several of the recent eruptions have happened on the Atrio side, it would seem as if the chief centre of volcanic action was tending towards that point, and there seems little doubt that one of the next eruptions will place the Observatory more or less in danger. Let us hope, however, that when that time arrives a worthy successor of Palmieri may safely chronicle what is going on, and that another De Saussure may be there to see.

WAGNER'S HANDBOOK OF CHEMICAL TECHNOLOGY

A Handbook of Chemical Technology. By Rudolph Wagner, Ph.D. Translated and edited from the eighth German edition, with extensive additions by William Crookes, F.R.S. (London: J. and A. Churchill, 1872.)

EVERY one who has studied chemistry from a scientific point of view must have been more or less struck with the fact that nearly all our manuals of chemistry have much of their space occupied with detailed descriptions of various manufacturing processes, and many must have asked why this is. It is not easy to see what utility there is in describing, in works professedly devoted to a scientific subject, such processes as those for the manufacture of chamois leather, wine, vinegar, china and earthenware, &c. &c.; and yet our largest and most ambitious manual, in common with its smaller companions, devotes scores of its pages to the consideration of such subjects. This fashion is much to be deprecated for many reasons: in the first place, these processes are utterly useless to the student, as, in the majority of cases, they illustrate no rule, elucidate no reaction. In the second, it is utterly impossible to do full justice to them in the space to which they must perforce be confined; and in the last, much valuable matter about the rarer elements and reactions is squeezed out of place altogether, or passed over with a mere mention.

This system has borne its natural fruit in the numberless questions bearing on manufactures which are to be found in all our chemical examination papers; and the result is that many a man passes with credit on the marks gained by answering such questions, while others who, perhaps, have a much better knowledge of the science, fall behind in the race, because they have not devoted their time to Technology.

It is not difficult to see how this state of things arose. It is not so many years (we were almost going to say months), since chemistry was regarded by the public much in the same way that they now look upon the higher mathematics, as something very mysterious, very good for a learned man to know—but utterly useless and "unpractical" for all ordinary purposes. Such being the case, writers of manuals no doubt felt it incumbent on them to gild the pill by introducing such matter as tended to show that there was such a thing as a practical application of chemistry to the Arts.

However, that time has passed. Perhaps no science has of late become so widely popular, and certainly none has advanced so rapidly towards accuracy as chemistry. It is, therefore, time for it to throw aside the crutches upon which it was bound to support itself whilst struggling for recognition and public favour, and to march boldly forward, depending on itself alone. As a means to this end, it is with great pleasure that we welcome Mr. Crookes's translation of Dr. Wagner's work. He has given us, in the form of a handbook, what could only before have been obtained either by searching in special treatises, or by reading much more cumbersome dictionaries; and the existence of this book cannot but have its influence in setting free much of the space hitherto occupied in educational works on chemistry, by perfunctory descriptions of technological processes.

We most heartily join with Mr. Crookes in the hope he expresses at the end of his preface—"We cannot let this work pass out of our hands without expressing the hope that, at no distant date, chairs of Technology will be founded in all our universities, and that the subject will be included in the curriculum of every large school." Such an event could not fail to have the happiest effects on all; for, while it would set free the scientific student from a subject he does not require, it would enable those wishing to become managers of works or manufacturers, to study their special subjects in the best possible way."

The work consists of 745 closely-printed pages, with 336 illustrations, and a copious index. The subjects are treated at considerable length, and with extreme lucidity; this is especially the case with the portions devoted to metallurgical processes, where every step is carefully traced, and all the latest forms of furnaces, &c., are represented by woodcuts. We notice, however, that the section on electro-metallurgy is shorter than could have been wished, and that no mention is made of the process of depositing nickel upon iron, &c.

In the section on explosive compounds, we have full details for the preparation of picrates, nitro-glycerin, guncotton, &c.,; though the author, perhaps led away by his chemical enthusiasm for these bodies, has treated gunpowder somewhat shortly, and the very interesting results obtained by the use of pebble, pellet, and prismatic powders, we do not see noticed at all; in fact, this article is decidedly behind the times. The preparation of salt, sulphur, soda, ash, bleaching-powder, &c., are well and fully treated, though we do not see Deacon's process for the preparation of chlorine mentioned.

The articles on glass and earthenware are remarkably good and full, as are those on cements and lime, paper, sugar, and spirit. Since March 1868, two editions of the work have been issued, making eight in all. Of the eighth, and last, translations have been made into French and Dutch, and everyone will thank Mr. Crookes for the quantity of new matter he has added. In conclusion, it need only be said that the formulæ are throughout molecular, and that the metric system of weights and measures is used, except where English quantities were indispensable. We feel sure that this book will permanently take its place among our manuals, and that the editor and translator will, in future editions, correct any little faults and errors which are, in so large a work, unavoidable; while he will keep it fully abreast of the times. R. F.

OUR BOOK SHELF

Ueber die Bedeutung der Entwickelung in der Naturgeschichte. Von Dr. A. Braun, Berlin.

Ueber die Auflösung der Arten nach natürliche r Zuchtwahl. Von einem Ungenannten, Hanover. (London: Williams and Norgate.)

THESE are two of the most recent of the numerous contributions which Germany has made to the literature of Darwinism. The first is an address delivered on the anniversary of the medical and surgical Frederick-William Institute in Berlin, and is a tribute to the enormous impetus given to physiological research by the promulgation of Mr. Darwin's theories. The writer, however, while fully adopting the principle of Evolution, leans to the views which have during the last few years greatly spread among naturalists, that any theory like that of natural selection, which does not recognise an inherent law of progress, is insufficient to account for the phenomena of the transmutation of species.

The second of these pamphlets is a more noteworthy production. The anonymous author also admits the principle of Descent by Evolution, but contends that the carrying out of this principle, so far from leading, as is generally supposed, to a multiplication of species and to a gradual rise to more and more perfect organic forms, must necessarily result in a gradual diminution in the number of species, a fusing together of form after form, and a descent to more lowly, instead of an ascent to more highly organised structures. With the origin of life he does not concern himself, but only with its future; and the succession of organised beings he compares not to a tree branching out into infinite ramifications, but to a river uniting in itself an infinitude of smaller streams. Whether the proposition is a serious one, or whether it is put forward as a *reductio ad absurdum* by a furtive opponent of Evolution, it is difficult to say; but the argument is carried out with considerable ability, and a strong point is made of the acknowledged degeneracy of many races of men from the condition of their ancestors, and of the gradual dying out of tribes and the consolidation of the human family into an ever decreasing number of types.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The National Herbarium

YOU will, perhaps, give admission to a few remarks on Dr. Hooker's instructive "Reply"[*] to my "Statement" of 16th May, 1872, bearing in mind that this "Statement" was called for in explanation of the grounds of my requirements and assignment of space in the Museum of Natural History, to be built at South Kensington, for the reception, uses, and applications of the National Herbarium, on the conviction that such would be continued and maintained in the metropolis.

Dr. Hooker had put in the van of his evidence,[†] and recommendations bearing on the reduction,[‡] limited applications,[§] and subordination to Kew [‖], of the Herbarium at the British Museum as regards supply,[*] nomenclature, and government, a summary of the amount of botanical work represented by the 140 volumes having the Herbarium at Kew as their cause or conditions.

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[*] See NATURE, vol. vi. p 516.

[†] Minutes of Evidence of Royal Commission on Scientific Instruction.

[‡] Ans. to Q. 6,683.

[§] Ans. to Q. 6,684 and 6,685

[‖] *Ibid.*

Seeing that—were this summary to be held as decisive, administratively, for carrying out his urgent desires—a Government impressed with its responsibilities for the application of public money, would place on retiring allowances the proportion of the staff no longer needed in the Metropolitan Herbarium—there was a motive in addition to my duty in response to the inquiry of the First Commissioner of Works, to sift the grounds of Dr. Hooker's attack on the Department of Botany in the British Museum. The anxieties of its officers were too well founded.

The argument from the amount of herbarium work at Kew since the practice of transferring there the dried plants collected in Government expeditions would be valid if such work could not be done elsewhere, or if such work had not been done in the Metropolitan Herbarium prior to the diversion therefrom of its legitimate supplies.

But the "Prodromus Floræ Novæ Hollandiæ," the "Observations Systematical and Geographical on the Herbarium collected in the Vicinity of the Congo," not to cite other works of Robert Brown, well known to botanists—and I may add the "Plantæ Javanicæ Rariores" of his successor, John Joseph Bennett, F.R.S.—are examples of "scientific work" at the London Herbarium, in relation to its legitimate supplies, which will bear comparison with the "scientific work which is turned out from the Herbarium at Kew."

The circumstance which, in the emergency threatening a Department of Natural History in the British Museum I was bound to submit to the consideration of Government, was that the works added to Botanical Science, for which before its supplies were intercepted by a "competing establishment" the National Herbarium in London furnished the materials for publication, were works of assigned duty. The officers of such Herbarium had no trusts or responsibilities in relation to the Royal Gardens, but gave their aid in naming the living Plants at Kew; leaving the officers in charge of those gardens free for the works and applications for which a Nation provides and supports its collections of living plants. Had Robert Brown been the director of such establishment, those who had the inestimable pleasure and benefit of his intimacy know that his devotion to the experimental and physiological duties of his office would have been the prime and paramount subject of his time and labours at Kew.

Permit me to exemplify my argument. In the "Report of the Royal Garden at Calcutta for 1870" (No. 585, 14th May, 1872) it is stated:—"At the beginning of the year the total stock of Ipecacuanha amounted to five plants in Sikkim and seven in this garden. These represented the only surviving offspring of a single plant received from Dr. Hooker of the Royal Gardens, Kew, in 1866.—At the request of the Right Hon. the Secretary of State for India, attention has for some years past been given in Edinburgh to the propagation of Ipecacuanha plants for this country, and during the past year the supplies raised there began to arrive. Five 'Wardian Cases' containing about 100 plants were received from Dr. Balfour of the Royal Botanical Gardens at Edinburgh." The Curator of these gardens, Mr. McNab, referring to the earlier introduction of living plants of *Cephaelis Ipecacuanha* into the Kew Gardens, and alluding to the slow and difficult method of its propagation by the adopted methods of cuttings, proceeds to describe the better method to which his experiments on living specimens led.[†] "The roots or rather rhizomes of the *Cephaelis* are peculiarly annulated (Pl. iv. fig. 2). A few of them were taken from one of the plants in the Botanic Garden during the month of August, 1869, and, after being cut into transverse sections of different lengths, were inserted in a horizontal position over the surface of a pot prepared with drainage and white sand. This pot was placed under a hand-glass in a warm propagating bed, and kept moist. A few weeks afterwards the root-cutting began to swell, and showed signs of budding, chiefly on the upper cut surface, as in Pl. iv. fig. 3. In most cases only one bud was developed, but in some instances two or more were produced. When several growing plants are observed the root can be cut through so as to form independent plants." If this has not before found a place in the columns of NATURE it may be deemed worthy of one, for, as the physiological botanist in charge of the Edinburgh Gardens observes—"Understanding that the Government intend to introduce the cultivation of the plant in India," and "in order to meet the demand which in all likelihood will be made on nurserymen for plants of *Cephaelis*, it is well to know how it can be propagated independently of cuttings" (*Ib.* p. 318).

To give another instance. In an obituary notice of Dr. Fred. Welwitsch, the editor of a horticultural journal refers to the species of a plant which bears his name as follows:—"The *Welwitschia mirabilis* is about as remarkable a plant as the *Rafflesia Arnoldi* itself, and equally uncultivatable."[*] The simple fact is, the ill success at Kew. One cannot be sure till Edinburgh has had its chance.

As a popular premier once defined dirt, so a weed is a plant multiplying in a wrong place. We may hope for a reversion of the sentence on *Welwitschia* when "cones with ripe seeds" and "fine young plants" have found their way to a botanic garden whose officers are not diverted from experimental work, nor trammelled and obstructed by that wasteful weed—an overgrown herbarium. The native conditions of existence of the Tumboa may then and there be imitated so truly, with ample provision for the descent of the tap-root, as to enable visitors to see the plant alive, and Mr. McNab may even succeed in giving other horticulturists the opportunity of multiplying specimens.

From such instances—and they might be multiplied—of legitimate successes, where a botanic garden is content to use the herbarium in the contiguous metropolis, and has not the low ambition of setting up a competing one in the garden itself, I infer an administrative advantage in maintaining the division of labour, which worked well in the days when the Government collections of live plants went to Kew, and those of dead plants to London.

I do not merely suggest, but affirm, that the nation loses part, perhaps much, of the benefit of the liberal grants and aids it affords to its garden of living plants through the uncalled-for and unnecessary accumulations there of collections of dead plants and the resulting herbarian work. Dr. Hooker evades the concluding argument of my statement, takes a personal stand-point, assumes the tone of an injured individual, and deems it unfitting to notice what he is pleased to call an "insinuation."

He who is most sensitive as to himself is often least mindful of the feelings of others. If Dr. Hooker will read his answer to Q. 6661 (op. cit., p. 434), he may, at least ought to, have some sense of the pain he inflicted on fellow-servants of the State and collaborators in science, on men at least his equals, and one of whom, in a recondite botanical problem, has shown himself his superior. Statements of a certain character may be made by one careless as to cost in few words and at small loss of time. It required the evidence occupying pp. 530, 531, of the published "Minutes" of the Scientific Commission to show the groundlessness of the insinuation conveyed in the answer to Q. 6661.

I will not now trespass further on your valuable space. But the "Kew Question" has assumed proportions, and may have consequences, meriting for it a thorough ventilation; and I permit myself to believe that you may not be unwilling to receive further remarks on those points in my "Statement" to which Dr. Hooker has condescended to reply.

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[*] Ans. to Q. 6,785, "That the British Museum Herbarium and that at Kew should be under one control, and the former be continuously added to from Kew." In his Ans. to Q 6,732, Dr. H. says—"The trouble of supplying the South Kensington Museum would be very trifling,"—which I think probable.

[†] McNab "On the Propagation of the Ipecacuanha plant," Transactions of the Botanical Society of Edinburgh, vol. x. p. 318.

[*] The *Garden*, Oct. 26, 1872.

Sheen Lodge, Oct. 30 RICHARD OWEN

Physics for Medical Students

I AM and have been a "medical student" for many years, and hope to live in that capacity for some years more. I admit that I *ought* to know "the relation between the surface temperature of the body, the quantity of heat passing away from it, and the amount of heat generated in the body by the food given to a patient," but I do not know all this, and I have never discovered anyone who can tell me where I can learn it or how I can find it out by any efforts of my own.

Moreover, I have been unable to get a clear and satisfactory answer to the following simple questions, and have failed to find anyone who will explain to me accurately how I am to set to work to get the information so much desired:—"What is the quantity of heat generated in the body by the food, and how is it to be determined? How is the quantity of heat that passes away from the body in a given time to be estimated with anything approaching to accuracy?" If my friend and colleague Prof. Adams will be so kind as to give answers to these questions in NATURE, I can assure him he will confer a great favour upon many workers and thinkers in my profession, besides proving the value of such questions as that objected to by Mr. Heath for medical students. At this time we doctors are much in need of physical help. I have no doubt that physicists will be much astonished at our ignorance, but never mind that; we are quite ready to learn, and don't mind being laughed at or even spoken of with slight contempt by our physical friends if they will only help us. Nay, we will suffer anything from those who will instruct us so that we may be able to set to work upon living people who are "generating" and giving off heat, and determine with accuracy the different rate at which heat is "generated" and given off under different circumstances.

Prof. Adams asks whether "the production of heat in the human body by the consumption of food" is "carried on on principles entirely different from those of the production of steam in a boiler," and seems to regard it as one of the "mildest of questions;" in heat that can be proposed for a medical student to answer. Will he answer his own question by asserting that the principles are the same in the two cases? Heat in the body, steam in the boiler—heat, steam; body, boiler!—or shall the question be revised before it is proposed to the student?

I have not the slightest doubt about the usefulness of a knowledge of physics to those who are working at medicine, and quite agree that the rising generation of medical students should be taught physics. But this is a very different thing from teaching people to fancy that living things are mechanisms, machines, galvanic batteries, or molecular apparatuses. I venture to think that some of the most distinguished physicists are too fond of deserting their own department for the purpose of trying to make people believe that there is an analogy between steam-boilers and human bodies, when no one has yet succeeded in proving that there is any true analogy whatever.

King's College, London LIONEL S. BEALE

IN the last number of NATURE Mr. Adams, of King's College, criticised the remarks made by Mr. Heath in his introductory address upon the character of the London University medical examinations, and of the first, the preliminary scientific, more especially. It scarcely needed a column and a quarter of close type for Mr. Adams to tell us that a medical man should be acquainted with physical laws and phenomena, and that in his opinion the mathematical question quoted by Mr. Heath was not too difficult to be fittingly placed in the examination paper. The former point is beyond question, and the latter is not to be settled by declaring the statement of the editor of the *Lancet* to be "shallow." As to the view that a medical man should be able to estimate precisely "the amount of heat lost through a blanket or a seal-skin coat," I will only say that it seems to me that a slight consideration of the physical and physiological conditions involved, and their variations in different instances, will suggest the hope that he will not waste his time in attempting such feats, simple as they may be deemed in physical laboratories. I will not take up space in commenting upon Mr. Adams' arguments and illustrations in support of his position, since they do but go to show that a medical man should have some knowledge of natural philosophy and its applications to the conditions with which he has to deal, and not that he should be driven to expend his time, already overcharged with much more that is of no possible use to him, upon mathematical processes which concern astronomers, chemists, and engineers. There is no doubt that to give a scientific character to medicine, exact quantitative methods must be applied to physiology and pathology, but it should be the work of men specially trained and devoted to the purpose. It has for some time past been commonly agreed that the medical student's education is such that he is urged to acquire a quantity of information with little regard to its use and digestibility. He has a great deal to learn in a short time. The chief part of his education consists, or should consist, in observing and comparing morbid conditions, and in learning or devising means for their relief and cure. Whatever time he spends upon what is not requisite, or has little direct bearing upon his art, implies time mis-spent and injury to the sufferers he will later attend. Prof. Huxley did not go too far in saying that the conduct of hose who impose useless knowledge upon medical students is mply criminal. F. LYNDON ATTWOOD

Junior Athenæum Club

NORTH POLAR EXPLORATION

IN the last number of the *Mittheilungen* Dr. Petermann publishes his 67th paper on the Geography and Discoveries of the Polar Regions, in which he gives an abstract of what has been done during the last three or four months.

The two projected Norwegian expeditions into the Siberian Seas, under the guidance of Captains Jensen and Mack, have at present been unfortunately frustrated; the former from a damage to the screw of the steamer, the latter from inability to penetrate the masses of ice. However, a projected scientific expedition for next year is exciting much interest at Tromsö. The French Expedition, under Ambert and Mack, has not yet put to sea, having been detained by the delay in settling the estate of Lambert, who left a large sum to be devoted to this purpose. This is much to be regretted, as Captain Mack has already distinguished himself by penetrating farther than any other discoverer into the Siberian Sea.

However, the much-talked-of and bold expedition under M. Octave Pavy, has, it is understood, at last left San Francisco, with what results remains to be seen. He expects to reach Wrangell Land by September 1, making his way farther northward in sledges, and hoping to come to open sea about May 1873. He will then proceed towards the Pole by means of a raft of somewhat novel construction, consisting of four hollow cylinders provided with a deck, and capable of holding all necessary provisions for Pavy and his small party for two years, by which time he expects to have reached the Pole, and returned to San Francisco. His companions are Dr. Chesmore, who has travelled much in Alaska; Captain Mike, who a few years ago attempted to cross the Atlantic in a vessel of somewhat similar construction to Pavy's; Watkins, a renowned Rocky Mountain hunter; and two sailors of whaling experience: in all, the expedition will consist of six men.

The latest news from the North American Expedition is contained in a letter from Dr. Bessels to Dr. Petermann, dated August 23, 1871, at which time the expedition had reached Tessinsak, the most northerly Danish settlement in Greenland, in lat. 73° 24′ N., and long. 56° 12′ W. Further details as to this expedition will be found in NATURE for September 19.

One of the most important and best fitted out expeditions is the Austrian one under Payer and Weyprecht, which left Tromsö in July, for the purpose of exploring the unknown region north of Siberia, to which they are prepared to devote three years. By the latest advices, about the end of July, the expedition was fairly on the road to its field of labour, and Count Wiltschek was to follow with a store of provisions, to be deposited near the Ice Cape, on the north of Nova Zembla, in case the expedition should be compelled to turn back.

Of the outfit and plan of the Swedish expedition we gave an account in NATURE for August 29. It left Tromsö on the 31st of July, and when last heard of was off the north-west point of Spitzbergen.

We are also favoured with a letter from Dr. Petermann, dated Gotha, October 11, from which we learn that the land on the east of Spitzbergen, which for the last 355 years has had a varying position on the map, has this year for the first time been reached by Captain Altmann of Hammerfest, and again on August 16 last by Captain Nils Johnsen of Tromsö, in his little sailing yacht the *Lydeana*, who landed and explored it. Captain Johnsen saw the island first when in N. lat. 78° 18′ 46,′and E. long. 30°; in the maps of 1617 it was marked as Wiche Land, between 78⅓° and 75½° N. lat. On the 17th of August he anchored near to the north point in 79° 8′ N. lat. and 30° 15′ E. long., for the purpose of landing and exploring the place. What Captain Altmann, looking from a distance, took to be three islands, Johnsen found in reality one, the high hills being connected by low lying land, with several outlying islets. On no part of the land has he found extensive snow-fields, and saw only one small glacier on the south-east coast, while, on the contrary, there are many large streams entirely free from ice. The greatest length of the land Captain Johnsen has found to be 44 geographical miles. Large quantities of driftwood extended here and there to about 100 feet from the coast, and rose to the height of at least 20 feet. The island abounds in the usual Polar fauna, the plentifulness of seals, especially *Phoca Groenlandica*, being noted by Johnsen. The reindeer on the island are spoken of as the largest and fattest which anyone on board the *Lydeana* had ever seen. The rocks seem to be principally of the quartz and argillaceous kind, and some fossils have been sent to Sweden and to Zurich. Captain Johnsen explored the east, south-east, and north-east coasts, and so far as his observations went, ice is to be found only on the north coast.

The fact of greatest significance in this latest news from these quarters is that for many months in the year the sea around Spitzbergen is almost entirely free from ice; a position long and sagaciously maintained by Dr. Petermann.

"Of interest," says the *Academy*, "in connection with this subject is an account of the finding of the relics of Barents' expedition of 1597 to Novaia Zemlia, by Captain Carlsen in 1871, prepared by M. de Jonge, and newly published under the auspices of the Dutch government at the Hague. The pamphlet contains the journal kept by Carlsen, and a minute description of the relics, accompanied by a photograph of these in a group, and charts comparing the Novaia Zemlia of Barents with the island as mapped from our present knowledge of it."

RESEARCHES IN GREENLAND[*]

WHEN I wrote to you last from Copenhagen, I anticipated that my season would be very short; and my anticipations were correct. The season, however, in Greenland has been long and brilliant. In the middle of May floe ice disappeared in Umenak Fiord, which was fully six weeks earlier than usual; and in April, in Godhavn men went about in summer attire. When I arrived (on July 6) the land was covered with flowers, the butterflies were beginning to appear, and almost all snow had vanished from the sea-level up to 2,000 ft. Since then, with the exception of a bad week in the Waigat, I have enjoyed the most exquisite weather that it is possible to imagine. In this arctic region it has only frozen on two nights, and during the daytime the thermometer has ranged from 50° to 70°. Until recently we have also had a high barometer; and, upon the whole, very little wind.

I have been upon Hare Island for three days, and have also been to Umenak, but the chief part of my time has been spent in the Waigat, where you would be surprised, perhaps, to find that a great deal remains to be done. I have found a great valley leading into the interior of Disco, and have gone up it a hard day's march. I have ascended one of the highest of the peaks on the Noursoak side of the Waigat, and looked down upon the great valley which occupies almost the whole of its interior. The lakes, as given upon Rink's map from reports of Eskimo, do not exist, but there is one very large lake which has a glacier or glaciers coming into it at perhaps 2,000 ft. above the sea. This valley is the most important one hitherto discovered in North Greenland. The river flowing down it has the character of a river, and not of a torrent; and, after descending through many windings a course of at least 100 miles, it pours into the sea a volume of water equal to that of the Rhone at the Lake of Geneva. At half a mile from the shore I found the water fresh.

In Umenak Fiord I ascended a mountain of about 7,000 ft. with five Greenlanders, and took my theodolite to the top. As you know the weight of the instrument, you will be partly able to appreciate this performance. The ascent, first over swamp, then over basalt *débris* which reposed insecurely upon solid basalt, and finally, at the top, up columnar basalt, was a sweet thing of its kind. The picture of your humble servant being lowered by a rope, dangling like a bundle from a crane, will, perhaps, to some people, be more interesting than the results obtained by the theodolite. These, however, were not unimportant. My peak, an isolated one, commanded a view of almost the whole of the Umenak district (which contains the highest mountains of Greenland proper), and a magnificent view of the "inland-ice." I found the general elevation of the mountains exceeded by about 2,000 ft. the height previously assigned to them. Of the altitude of the "inland ice" I shall write on a subsequent occasion.

A large part of my time in the Waigat was occupied by the measurement of a base line. This was the most important piece of work that I undertook, and it was successfully executed. I find the Waigat to have in some places scarcely half the width which our maps give it. I find its mountains to be about double the altitude that they have been supposed to be; and Hare Island I find to be twice the length represented upon the Admiralty Chart; Hare Island has some points of particular interest. I got from it a rather large collection of fossil plants, and went to its top (1,800 ft.). From the summit, at midnight, I distinctly recognised the mountain called Sanderson's Hope, near Upernavik, which was distant from me 140 miles!

I have made an excellent journey, full of interest. My collections are at least as valuable as those of 1867, though, as far as I know, they do not contain anything of the importance of the *Magnolia*. I have, however, even larger collections of fossil plants than before, and from localities which I did not visit in 1867. My stone implements are very numerous, and of good quality, and the natural history specimens are not few in number. Altogether I am very well content.

EDWARD WHYMPER

Written on board the brig Hvalfisken *as it proceeded out of the harbour of Godhavn, Sept.* 10, 1872.

THE HELVETIC SOCIETY OF NATURAL SCIENCES

THE 55th Session of this Society was held at the ancient city of Fribourg on the 19th, 20th, and 21st of August last, and of it we have again to tell of an overwhelmingly hospitable reception by "our hosts of Fribourg;" a well-attended opening address by the President, Dr. Thurler; sectional *séances*, at which many valuable papers were read, followed by fruitful discussions; a final general meeting to listen to something that would interest all, and then the dispersion. This Society appears to be satisfactorily accomplishing its professed aim of increasing the interests of the people generally in scientific studies, of establishing intimate and familiar relations between men of science engaged upon the same subject, and of fostering a harmonious spirit of labour all over the country. We give an abstract of the report contained in the *Bibliothèque Universelle.*

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[*] Copy of a letter addressed to Mr. R. H. Scott, F.R.S., and kindly forwarded by him to us.—ED.

Prof. Volpicelli gave a paper on Atmospheric Electricity and the best method of studying it. Having made experiments, in calm weather, according to the methods both of Franklin and of Peltier (in the former of which a fixed uninsulated rod is used, connected with an electrometer by a wire, while in the latter a moveable metallic point with similar connection is sent up into the atmosphere), he found the results always contradictory as regards the quantity, and sometimes also as regards the quality, of electricity indicated.

On all the days in which the air was not much agitated, the time and circumstances being the same, the moving rod gave a greater quantity of electricity than the fixed; and the former often showed positive electricity, while the latter showed negative.

It has been shown that the earth is a body negatively electrified. It follows that any conducting substance is electrified positively when it rises in the atmosphere, and becomes negative, on the other hand, as it descends. The indications of the metallic rod shot into the air are therefore modified by the influence of the earth, and do not give a means of determining the electricity of the surrounding atmosphere. Franklin's fixed rod, on the other hand, is free from these disturbing influences.

That a conductor gives positive electricity as it rises in the atmosphere, and negative as it descends, may be proved by experiment. Suppose, *e.g.*, the fixed rod gives negative electricity; if a flame be applied to the point of it, the apparatus will indicate positive electricity. The flame produces an upward current of air, which, by its motion, and under the influence of the earth, gives a neutralising positive electricity, so that the point of the fixed rod becomes positively charged. (It is necessary that the flame should have a high calorific power.)

If the flame be now brought down to the ground, one or other of three effects will occur:—if the flame is not very strong, negative electricity will be indicated; if somewhat hotter, there will be no electricity at all; if very intense, the electricity will be positive. These effects are readily explained as the resultants of two opposing actions, the production of positive electricity by the ascending current of air, and the production of negative through the influence of the earth on the descending flame. The general inference Prof. Volpicelli draws is the preferability of Franklin's method to the other.

M. Müller, professor at Fribourg, gave an account of experiments on the lower Glacier of the Grindelwald, with reference to the optical properties of glacial ice. His experiments partly confirm the results obtained by MM. Grad and Dupré, that thin lamellæ of ice cut horizontally at the base of the glacier, give, in Norremberg's apparatus, systems of coloured rings with a dark cross. This property, moreover, appears only at certain separate parts of the lamella, and the system of rings is always more or less incomplete, which is sufficiently explained by the irregular structure of the ice of glaciers, in which, necessarily, there are only distant traces of the mode of original formation. Vertical sections gave no coloured rings.

M. Louis Dufour described some important researches on the Diffusion of Gases across diaphragms and the variations of temperature accompanying it. He studied the cases (among others) of hydrogen and air, of air and carbonic acid.

He distinguishes the diffusion at constant pressure, and the diffusion with change of pressure. The porous vessel containing the gas with slower diffusion contains also a very sensitive thermometer, and is enclosed in another vessel, in which the other gas circulates. A glass tube, passing through the stopper of the porous vessel, can be put in communication either with external air (pressure constant) or with a manometer. The whole is enclosed in an envelope of cotton. The thermometer is observed with a cathetometer.

1. Diffusion at constant pressure.—First of all, taking as example hydrogen and air, equilibrium of temperature is established between the air outside of the porous vessel and that inside; then hydrogen is made to circulate, and it is seen that the thermometer in the interior falls. A large number of experiments showed that there is always a rise of temperature on the side of the entering gas, and a fall of temperature on the side of the escaping gas. M. Dufour believes this change of temperature does not take place throughout the gaseous mass, but only at the surface of the diaphragm. He conceives that at the part where the gas enters there is condensation and compression, causing development of heat. In the opposite case there is expansion of the gas, and hence absorption of heat.

2. Diffusion with change of pressure.—In this case the phenomenon is complicated by variations in the temperature according to the pressure. When the diffusing gas enters the porous vessel, the thermometer indicates first a slight rise of temperature resulting from rapid increase of pressure; it then falls, and to a much greater extent ($\frac{1}{10}$ of a degree *e.g.*) commences again to rise gradually, falls a little again, in consequence of the escape of the other gas and the rarefaction produced; then continually rises. The effects are represented by a curve.

M. Dufour also studied the case of diffusion between dry air and moist air. He observed there was always diffusion between two quantities of air having different degrees of humidity; and, contrary to what one might expect from Graham's law (the vapour of water being lighter than air), the diffusion takes place from the dry to the humid. The laws of variation of temperature in this case conform to what M. Dufour observed in the case of two gases. The diffusion is readily indicated by a water manometer, and M. Dufour thinks the principle might be applied in hygrometry. It is evident that the general principle must have numerous applications in the organic world. M. Reichert described a thermo-regulator, in which the mercury of a thermometer which was placed in a heated liquid interrupted, on rising to a certain point, the passage of the heat-producing gas.

M. Mousson described a method for measuring the dispersion in the different parts of the spectrum furnished by a prism or any spectroscope whatever. The dispersion varies, it is known, in the different portions of the spectrum obtained with a prism, it is believed much less rapidly in the red, much more rapidly in the violet. The law according to which it varies changes according to the different prisms and different substances used. M. Mousson proposes a new simple process by means of which the law can be directly determined for each spectroscope. It consists in observing with the spectroscope the spectrum given by a network (*réseau*) of diffraction, of which the lines ought to be perpendicular if the edges of the prism are horizontal. There is thus obtained a curved spectrum, which is the graphic representation of the law sought.

Other papers in the section were by M. de la Rive on the rotation of the electric discharge in rarified gases under the influence of a magnet, and particularly upon the mechanical action which this discharge could exercise in its rotating movement. M. E. Hagenbach expounded the principal results of his beautiful researches upon Fluorescence:

and M. Volpicelli concluded the work of the section by a communication on Electrostatic Induction.

Geology is the branch of Natural History which is most cultivated in Switzerland. Notwithstanding its small extent, that country has the most varied field for observation in the mountain-chains of the Jura and the Alps; there are few important questions whose solution cannot be found in these mountains; and many Swiss names are found among those who have done most to advance that science. During the last year geological studies have received a great impulse in Switzerland by the subsidies which the Confederation vote for that purpose; each year the State grants a sum in aid of the researches of a certain number of geologists, and for the study of a new part of the territory. The works which result are published under the care of a special commissioner of the Society of Natural Science. As might be expected then, the Geological Section was very numerously attended, and the papers read on the subject were many and valuable. We learn from M. A. Fauzes' general lecture that the Society have taken similar steps for the study and preservation of Swiss boulders to those taken by the Royal Society of Scotland, whose report we gave in a recent number.

M. V. Gross brought under the notice of the members a series of objects belonging to the lacustrine dwellings of the Lake of Bienne, worthy of the attention even of those who have seen the richest collections of this kind. There was the bit of a bridle almost complete belonging to the station of Mörigen, which belongs to the age of bronze; at the present time only one similar fragment is known. Incrustations of iron upon a bronze knife tend to confirm what has already been conjectured, that at the first appearance of iron it was regarded as a most precious metal. The station of Lüschersz, of the stone age, has been discovered by M. Gross, and has furnished axes of nephrite and jade of a size not hitherto met with in lacustrine dwellings. It is known that these rocks are not found in Europe; and it is a question whether these lake-dwellers obtained them by commercial intercourse with Asia, or whether these rare articles were preserved as heirlooms in families from the period of their emigration from their ancient Asiatic home.

M. Ch. Vogt communicated to the section the results of his microscopic study of rocks. One of the questions which he wished to resolve is whether the microscope can enable us to know whether or not a rock has ever been in an igneous state. M. Vogelsang has discovered that the volcanic rocks present what has been called the "fluidal structure," a structure resulting from the disposition of minute crystals disseminated throughout the vitreous mass, and surrounding the larger crystals which have been previously formed in the lava. This fluidal structure is found in the porphyries, and proves their igneous origin. But on examining the siliceous deposits of the Geyser, M. Vogt found this same structure, and thus it does not belong exclusively to the igneous rocks, but also to those of aqueous origin, provided that they have been in a viscous state. In his study of volcanic rocks, M. Vogt has discovered that the trachytes, the basalts, and the lavas, present common characteristics.

M. Lebert brought under the notice of the section a magnificent series of specimens of amber, and expounded the results of his researches on that substance. The fluorescence of petroleum may be taken as a type of the same phenomenon in amber. For naturalists the most interesting of M. Lebert's specimens are fragments of the conifers which produced the amber, a piece enclosing a movable air-bubble in a drop of water, and a great number of other pieces enclosing insects in a perfect state of preservation.

M. François Forel exhibited a photograph of the fossil man of Mentone, which represents him in the position in which he was found. It would appear that this man was not buried under a landslip, but that he must have been interred by those who survived him. It is argued that, because it is very unusual to inter the dead in a dwelling for the living, we may conclude that this individual belonged to a nomad horde of the age of the reindeer, who did not inhabit the cavern, but passed it from time to time, and who buried this man in the place where he died. We may mention here that in the Zoological section Dr. Vonga read a paper on the same subject, he having been present at the exhumation of the body. He described the caves, and pointed out their probable mode of formation. The body lay upon its left side in the position of sleep. It showed a circular crack at the base of the skull, the thorax being broken at one place; the remainder is in perfect preservation. The cranium is very fine, all the teeth being preserved; the lower jaw is long, but the angle between the horizontal and the ascending branches is a right angle. Dr. Vonga attributed the remarkable preservation of the body to the properties of the pulverised earth which covered it.

Several members presented to the section their studies of various parts of the Alps, and M. E. Favre read a paper on a section of the Caucasus. In the centre of the latter chain a granitic formation is found. On the two sides palæozoic schists are presented, analogous to those of Grätz, and connected by veins of crystalline schist. They are less developed on the north side than on the other. Upon the northern slope the Secondary and Tertiary formations are in a very normal position, and have but little inclination; upon the other slope, on the contrary, there are many zones of eruptive rocks, and the Secondary formations are less disturbed. M. Favre also spoke to the section on the lower limit of eternal snow and the glacial phenomena which he has observed in this chain.

In the section of Zoology Prof. C. Vogt presented the results of his researches upon the *Phyllopodes*, especially the Branchiopods and the *Artemia*.

M. Vogt confirmed the observation of M. Joly, that among the *Artemiæ* collected at Cette during the months of July and August, no males were found, and that the females reproduced by parthenogenesis. This fact is so much the more singular that large numbers of males are found in other salt marshes inhabited by the same or analogous species.

M. Auguste Forel presented to the section some curious and interesting results of his researches into the nature and habits of ants. Different communities of ants, even when they are of the same species, are enemies to each other. A single community of ants may possess many nests, which are connected with each other by galleries and tunnels. A community of ants may be either simple or mixed; it is simple when it belongs to a single species, mixed when it belongs to two or more species living on good terms among themselves. There are in each community, at one time at least, workers, some males and females. If we consider the mixed communities, we can distinguish, amongst others, slave-ants, obtained by the workers of one species pillaging the ant-hills of another species, and carrying off the cocoons. These, when once hatched, become the auxiliary workers and friends of their captors, doubtless believing that they are of the same origin. The mixed community contains the three sexes of the species who plundered, but only the workers of the species pillaged.

The only paper apparently of importance in the Botanical Section was by Dr. Müller, of Geneva, on a new species of *Loranthus* from the Philippine Islands, which, from the position of the flowers, presents some very extraordinary but not yet well-established peculiarities.

Other papers of value were read in the various sections, and, considering that the meeting lasted only three days, the amount of work gone through appears extraordinary but then no mention is made of any excursions.

ON THE WYANDOTTE CAVE AND ITS FAUNA *

THE Wyandotte Cave traverses the St. Louis Limestone of the Carboniferous formation in Crawford County, in South-Western Indiana. I do not know whether its length has ever been accurately determined, but the proprietors say that they have explored its galleries for twenty-two miles, and it is probable that its extent is equal to that of the Mammoth Cave in Kentucky. Numerous galleries which diverge from its known courses in all directions have been left unexplored.

The Wyandotte Cave is as well worthy of popular favour as the Mammoth. It lacks the large bodies of water which diversify the scene in the latter, but is fully equal to it in the beauty of its stalactites and other ornaments of calcyte and gypsum. The stalactites and stalagmites are more numerous than in the Mammoth, and the former frequently have a worn, or maccaroni-like form, which is very peculiar. They twist and wind in masses like the locks of Medusa, and often extend in slender runners to a remarkable length. The gypsum rosettes occur in the remote regions of the cave, and are very beautiful. There are also masses of amorphous gypsum of much purity. The floor in many places is covered with curved branches, and, what is more beautiful, of perfectly transparent acicular crystals, sometimes mingled with imperfect twin-crystals. The loose crystals in one place are in such quantity as to give the name of "Snow Banks" to it. In other places it takes the form of japanning on the roof and wall rock.

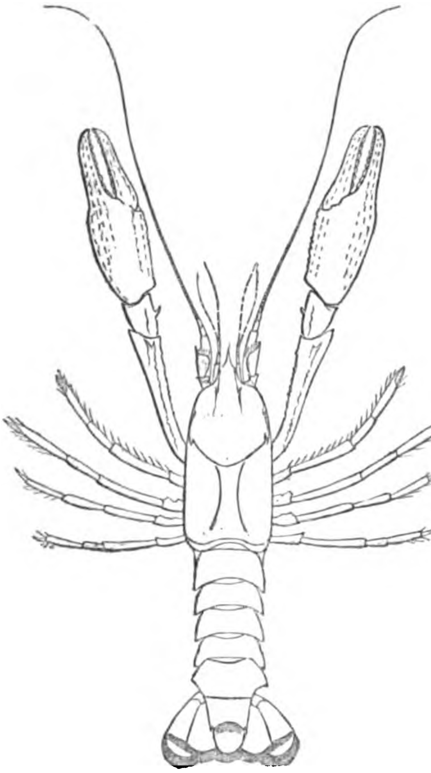

FIG. 1.—*Orconectes inermis* Cope, natural size.

In one respect the cave is superior to the Mammoth—in its vast rooms, with step-like domes, and often huge stalagmites on central hills. In these localities the rock has been originally more fractured or fragile than elsewhere, and has given way at times of disturbance, piling masses on the floor. The destruction having reached the thin-bedded strata above, the breaking down has proceeded with greater rapidity, each bed breaking away over a narrower area than that below it. When the heavily-bedded rock has been again reached, the breakage has ceased, and the stratum remains as a heavy coping stone to the hollow dome. Of course the process piles a hill beneath, and the access of water being rendered more easy by the approach to the surface, great stalactites and stalagmites are the result. In one place this product forms a mass extending from floor to ceiling, a distance of thirty or forty feet, with a diameter of twenty-five feet, and a beautifully fluted circumference. The walls of the room are encrusted with cataract-like masses, and stalagmites are numerous. The largest room is stated to be 245 feet high, and 350 feet long, and to contain a hill of 175 feet in height. On the summit are three large stalagmites, one of them pure white. When this scene is lit up it is peculiarly grand to the eye of an observer at the foot of the long hill, while it is not less beautiful to those on the summit. There is no room in the Mammoth Cave equal to these two.

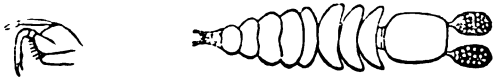

FIG. 2. FIG. 3.

Cæcidotea microcephala Cope.—Fig. 2: The mandible and palpi of right side more enlarged. The outer palpus lies above the lateral plate, and its origin was not seen. Fig. 3: The same; magnified 6·5 times.

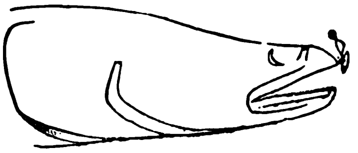

FIG. 4.—*Cauloxenus stygius* in position on the lip of *Amblyopsis spelæus*, enlarged.

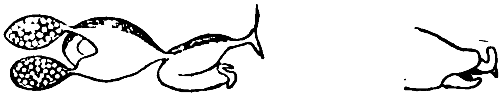

FIG. 5. FIG. 6.

Cauloxenus stygius.—Fig. 5: Antennal processes and muzzle more enlarged. Fig. 6: The animal viewed from below, with an infero-lateral view of the cephalothorax.

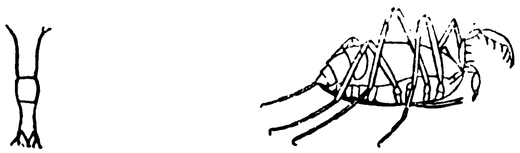

FIG. 7. FIG. 8.

Erebomaster flavescens.—Fig. 7: Male organ from below. Fig. 8: The same; magnified 7·6 times.

An examination into the life of the cave shows it to have much resemblance to that of the Mammoth. The following is a list of sixteen species of animals which I obtained, and by its side is placed a corresponding list of the species obtained by Mr. Cooke and others, at the Mammoth Cave. These number seventeen species. As the Mammoth has been more frequently explored, while two days only were devoted to the Wyandotte, the large number of species obtained in the latter suggests that it is the richer in life. This I suspect will prove to be the case, as it is situated in a fertile region. Some of the animals were also procured from caves immediately adjoining, which are no doubt connected with the principal one.

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* Reprinted from the *American Naturalist*, to the kindness of the editor of which journal we are also indebted for the loan of the cuts.

Of the out-door fauna which find shelter in the cave, bats are, of course, most numerous. They are probably followed into their retreat by the eagle and other large owls. The floors of some of the chambers were covered to a considerable depth by the castings of these birds, which consisted of bats' fur and bones. It would be worth while to determine whether any of the owls winter there.

LIST OF LIVING SPECIES IN THE TWO CAVES.

WYANDOTTE.	MAMMOTH.
Vertebrata.	
Amblyopsis spelæus DeKay.	Amblyopsis spelæus DeKay.
	Typhlichthys subterraneus Girard.
Arachnida.	
Erebomaster flavescens Cope.	Acanthocheir armata Tellk.
	Phrixis longipes Cope.
Anthrobia.	Anthrobia monmouthia Tellk.
Crustacea.	
Orconectes inermis Cope.	Orconectes pellucidus Tellk.
Cæcidotea microcephala Cope.	Cæcidotea stygia Pack.
Cauloxenus stygius Cope.	Stygobromus vitreus Cope.
Insecta.	
Anophthalmus tenuis Horn.	Anophthalmus Menetriesii Motsch.
Anophthalmus eremita Horn.	Anophthalmus Tellkampfii Erichs.
Quedius spelæus Horn.	Adelops hirtus Tellk.
Lesteva sp. nov. Horn.	
Raphidophora.	Raphidophora subterranea Scudd.
Phora.	Phora.
Anthomyia.	Anthomyia.
Machilis,	Machilis.
Campodea sp.	Campodea Cookei Pack.
Tipulid	
Myriopoda.	
Pirostrephon cavernarum Cope.	Scoterpes Copei (Pack.).

The blind fish of the Wyandotte Cave is the same as that of the Mammoth, the *Amblyopsis spelæus* DeKay. It must have considerable subterranean distribution, as it has undoubtedly been drawn up from four wells in the neighbourhood of the cave. Indeed, it was from one of these, which derives its water from the cave, that we procured our specimens. We descended a well to the water, some twenty feet below the surface, and found it to communicate by a side opening with a long low channel, through which flowed a lively stream of very cold water. Wading up the current in a stooping posture, we soon reached a shallow expansion or pool. Here a blind crawfish was detected crawling round the margin, and was promptly consigned to the alcohol bottle. A little farther beyond, deeper water was reached, and an erect position became possible. We drew the seine in a narrow channel, and after an exploration under the bordering rocks, secured two fishes. A second haul secured another. Another was seen, but we failed to catch it, and on emerging from the cave I had a fifth securely in my hand, as I thought, but found my fingers too numb to prevent its freeing itself by its active struggles.

If these Amblyopses be not alarmed, they come to the surface to feed, and swim in full sight like white aquatic ghosts. They are then easily taken by the hand or net, if perfect silence is preserved, for they are unconscious of the presence of an enemy except through the medium of hearing. This sense is, however, evidently very acute, for at any noise they turn suddenly downward and hide beneath stones, &c., on the bottom. They must take much of their food near the surface, as the life of the depths is apparently very sparse. This habit is rendered easy by the structure of the fish, for the mouth is directed partly upwards, and the head is very flat above, thus allowing the mouth to be at the surface. It thus takes food with less difficulty than other surface feeders, as the perch, &c., where the mouth is terminal or even inferior; for these require a definite effort to elevate the mouth to the object floating on the surface. This could rarely be done with accuracy by a fish with defective or atrophied visual organs. It is therefore probable that fishes of the type of the *Cyprinodontidæ*, the nearest allies of the *Hypsæidæ*, and such *Hypsæidæ* as the eyed *Chologaster*, would possess in the position of the mouth a slight advantage in the struggle for existence.

The blind crawfish above mentioned is specifically distinct from that of the Mammoth Cave, though nearly related to it. I call it *Orconectes inermis*, separating it generically from *Cambarus*, or the true crawfishes, on account of the absence of visual organs. The genus *Orconectes*, then, is established to include the blind crawfishes of the Mammoth and Wyandotte Caves.

Dr. Packard has described an interesting genus of Isopoda allied to the marine form *Idotæa*, which Mr. Cooke discovered in a pool in the Mammoth Cave. He called it *Cæcidotea*. I obtained a second species in a cave adjoining the Wyandotte which differs in several important respects. I call it *Cæcidotea microcephala*. Both species are blind. The new species is pure white. It was quite active, and the females carried a pair of egg-pouches full of eggs. The situation in which we found it was peculiar. It was only seen in and near an empty log trough used to collect water from a spring dripping from the roof of one of the chambers.

The Lernæan, *Cauloxenus stygius* Cope, is a remarkable creature. It is a parasite on the blind fish, precisely as numerous species near of kin attach themselves to various species of marine fishes. The Wyandotte species is not so very unlike some of these. It is attached by a pair of altered fore-limbs, which are plunged into the skin of the host, and held securely in that position by the barbed or recurved claws. No parasitic male was observed in the neighbourhood of the female, and it is probable that, as in the other *Lernæopodidæ*, he is a free swimmer, and extremely small. The difficulty of finding his mate on an active host-fish must be augmented by the total darkness of his abode, and many must be isolated owing to the infrequent and irregular occurrence of the fish, to say nothing of the scarceness of its own species.

The allied genera, *Achtheres* and *Lernæopoda*, present very distinct distributions, the former being fresh water and the latter marine. *Lernæopoda* is found in the most varied types of fishes and in several seas; *Achtheres* has been observed on perch from Asia and Europe, and on a South American *Pimelodus*. It is to the latter that *Cauloxenus* is most nearly allied, and from such a form we may, perbaps, trace its descent; modification being consequent on its wandering into subterranean streams. The character which distinguishes it from its allies is one which especially adapts it for maintaining a firm hold on its host, *i.e.*, the fusion of its jaw-arms into a single stem.

Whether the present species shared with the *Amblyopsis* its history and changes, or whether it seized upon the fish as a host at some subsequent period, is a curious speculation. Its location at the mouth of the fish could scarcely be maintained on a species having sight; for if the host did not remove it, other individuals would be apt to.

I may here allude to another blind Crustacean which I took in the Mammoth Cave, and which has been already mentioned in the Annals and Magazine of Natural History as a Gammaroid. Mr. Cooke and myself descended a hole, and found, a short distance along a gallery, a clear spring, covering, perhaps, an area ten feet across. Here Mr. Cooke was so fortunate as to procure the *Cæcidotea stygia*, while I took the species just mentioned, and which I name *Stygobromus vitreus*. The genus is new, and represents in a measure the *Niphargus* of Schiödte found in the caves of Southern Europe. This genus has several species in fresh waters, which are of small size, and swim actively, turning on one side or the other.

Of Insects I took four species of beetles, all new to science; two of them of the blind carnivorous genus *Anopthhalmus*, and two *Staphylinidæ*, known by their very short wing-cases and long, flexible abdomen. Dr. George H. Horn has kindly determined them for me.

One of them, the *Quedius spelæus*, Horn, is half an inch in length, and has rather small eyes; it was found not far from the mouth of the cave. Dr. Horn furnishes me with the following list of Coleoptera from the two caves in question :—

Anophthalmus	Tellkampfii Erichs.	Mammoth Cave.
,,	Menetriesi Motsch. *angulatus* Lec.	Mammoth Cave.
,,	eremita Horn.	Wyandotte Cave.
,,	tenuis Horn.	Wyandotte Cave.
,,	striatus Motsch.	Mammoth Cave. Unknown to me.
,,	ventricosus Motsch.	Mammoth Cave. Unknown to me.
Adelops hirta Tellk.		Mammoth Cave.

These are the only true cave insects at present known in these faunæ. Other species were collected within the mouths of the caves, but which cannot be classed with the preceding, as cave insects proper.

Catops n. sp.?	Wyandotte Cave.
Quedius spelæus Horn.	Wyandotte Cave.
Lestev n. spa.	Wyandotte Cave.

And another Alæocharyde Staphylinide, allied to *Tachyusa*, also from Wyandotte Cave. No names have as yet been given to any of these, excepting the second. A monograph of Catops has already appeared containing many species from our fauna; and as the work is inaccessible at present, I have hesitated to do more than indicate the presence of the above species.

The cricket of the Wyandotte Cave is stouter than that of the Mammoth, and thus more like the *Raphidophora lapidicola* of the forest. There were three species of flies, one or more species of *Poduridæ*, and a *Campodea* not determined.

Centipedes are much more abundant in the Wyandotte than in the Mammoth Cave. They especially abounded on the high stalagmites which crown the hill beneath the Mammoth dome, which is three miles from the mouth of the cave. The species is quite distinct from that of the Mammoth Cave, and is the one I described some years ago from caves in Virginia and Tennessee. I call it *Spirostrephon cavernarum*, agreeing with Dr. Packard that the genus *Pseudotremia*, to which it was originally referred, is of doubtful validity. The allied form found by Mr. Cooke in the Mammoth Cave has been described by Dr. Packard as *Spirostrephon Copei*. It is eyeless, and is, on this account alone, worthy of being distinguished generically from *Spirostrephon*. This genus may be then named *Scoterpes*. I look for the discovery of *S. cavernarum* in the Mammoth Cave.

Two species of Arachnidans were observed, one a true spider, the other related to the "long-legs" of the woods. A species similar to the former is found in the Mammoth Cave, and others in other caves, but in every instance where I have obtained them they have been lost by the dissolution of their delicate tissues in the impure alcohol. The other forms are more completely chitinised, and are easily preserved; they are related to the genus *Gonyleptes*, found under stones in various portions of the country. Dr. Wood describes a species from Texas, and I have taken them in Tennessee and Kansas. In the Wyandotte Cave I found a number of individuals of a new species, at a place called the screw-hole. Though living at a distance of four or five miles from the mouth of the cave, this species is furnished with eyes. This species is described as *Erebomaster flavescens* Cope. In its relationships it may be said to stand between *Acanthocheir* and *Gonyleptes*.

Besides *Acanthocheir*, another blind Gonyleptid exists in the Mammoth Cave, which I found several miles from the mouth. It is blind like the former, but differs in having many more joints to the tarsi, approaching thus the true *Phalangia*, or long-legs.

Dr. Packard and Mr. Putnam have already discussed the question of the probability of the origin of these blind cave animals by descent from out-door species having eyes. I have already expressed myself in favour of such view, and deem that in order to prove it we need only establish two or three propositions. First, that there are eyed genera corresponding closely in other general characters with the blind ones; second, that the condition of the visual organs is in some cave type variable; third, if the abortion of the visual organs can be shown to take place coincidently with general growth to maturity, an important point is gained in explanation of the *modus operandi* of the process.

First, as to corresponding forms; the *Typhlichthys* of the Mammoth is identical with *Chologaster*, except in its lack of eyes. *Orconectes* bears the same relation to *Cambarus*; *Stygobromus* bears nearly the same to *Gammarus*; and *Scoterpes* is *Spirostrephon* without eyes and no pores.

Secondly, as to variability. I have already shown that in *Gronias nigrilabris*, the blind Silurid from the Conestoga in Pennsylvania, while all of several specimens observed were blind, the degree of atrophy of the visual organs varies materially, not only in different fishes, but on different sides of the same fish. In some the corium is imperforate, in others perforate on one side, in others on both sides, a rudimental cornea being thus present. In some the ball of the eye is oval, and in others collapsed. This fish is related specifically to the *Amiurus nebulosus* of the same waters, more nearly than the latter is to certain other Amiuri of the Susquehanna river basin to which the Conestoga belongs, as for instance the *A. lynx*; it may be supposed to have been enclosed in a subterranean lake for a shorter time than the blind fishes of the Western Caves, not only on account of the less degree of loss of visual organs, but also in view of its very dark colours.

Thirdly, it is asserted that the young *Orconectes* possess eyes, and that perhaps those of the *Typhlichthys* do also. If these statements be accurate, we have here an example of what is known to occur elsewhere, for instance, in the whalebone whales. In a fœtal stage these animals possess rudimentary teeth like other Cetacea, which are subsequently absorbed. This disappearance of the eyes is regarded with reason by Prof. Wyman as evidence of the descent of the blind forms from those with visual organs. I would suggest that the process of reduction illustrates the law of "retardation," accompanied by another phenomenon. Where characters which appear latest in embryonic history are lost, we have simple retardation—that is, the animal in successive generations fails to grow up to the highest point, falling farther and farther back, thus presenting an increasingly slower growth in this special respect. Where, as in the presence of eyes, we have a character early assumed in embryonic life, the retardation presents a somewhat different phase. Each successive generation, it is true, fails to come up to the completeness of its predecessor at maturity, and thus exhibits "retardation;" but this process of reduction of rate of growth is followed by its termination in the part long before growth has ceased in other organs. This is an exaggeration of retardation. Thus the eyes in the *Orconectes* probably once exhibited at maturity the incomplete characters now found in the young, for a long time a retarded growth continuing to adult age before its termination was gradually withdrawn to earlier stages. Growth ceasing entirely, the phase of atrophy succeeded, the organ became stationary at an early period of general growth, being removed, and its contents transferred to the use of other parts by the activity of "growth force." Thus, for the loss of late assumed organs we have "retardation," but for that of early assumed ones, "retardation and atrophy."

The mutual relations of this cave life form an interesting subject. In the first place, two of the beetles, the crickets, the centipede, the small crustaceans (food of the blind fish) are more or less herbivorous. They furnish food for the spiders, crawfish, *Anophthalmus*, and the fish. The vegetable food supporting them is in the first place fungi which, in various small forms, grow in damp places in the cave, and they can always be found attached to excrementitious matter dropped by the bats, rats, and other animals which extend their range to the outer air. Fungi also grow on the dead bodies of the animals which die in the caves, and are found abundantly on fragments of wood and boards brought in by human agency. The rats also have brought into fissures and cavities communicating with the cave, seeds, nuts, and other vegetable matters, from time immemorial, which have furnished food for insects. Thus rats and bats have, no doubt, had much to do with the continuance of land life in the cave, and the mammals of the post-pliocene or earlier period, which first wandered and dwelt in its shades, were introducers of a permanent land life.

As to the small crustaceans, little food is necessary to support their small economy, but even that little might be thought to be wanting, as we observe the clearness and limpidity of the water in which they dwell. Nevertheless the fact that some cave waters communicate with outside streams is a sufficient indication of the presence of vegetable life and vegetable *débris* in variable quantities at different times. Minute fresh water algæ no doubt occur there, the spores being brought in by external communication, while remains of larger forms, as confervæ, &c., would occur plentifully after floods. In the Wyandotte Cave no such connection is known to exist. Access by water is against the current of small streams which discharge from it. On this basis rests an animal life which is limited in extent, and must be subject to many vicissitudes. Yet a fuller examination will probably add to the number of species, and of these, no doubt, a greater or less number of parasites on those already known. The discovery of the little Lernæan shows that this strange form of life has resisted all the vicissitudes to which its host has been subjected. That it has outlived all the physiological struggles which a change of light and temperature must have produced, and that it still preys on the food of its host, as its ancestors did, there is no doubt. The blindness of the fish has favoured it in the "struggle for existence," and enabled it to maintain a position nearer the commissariat, with less danger to itself than did its forefathers. E. D. COPE

SCOTTISH COAL FIELDS

THE "Journal of the Iron and Steel Institute" for August contains Prof. Geikie's paper read at the recent meeting in Glasgow "On the Geological Position and Features of the Coal and Ironstone-bearing Strata of the West of Scotland." The paper is meant chiefly for the benefit of those who are acquainted only with the British Carboniferous strata as seen in the English coal-fields, and to point out the geological position of the Scottish carboniferous deposits as contrasted with those of England. A geological map of Scotland shows that the Carboniferous formation is for the most part restricted to that broad belt of undulating low ground that extends from sea to sea, between the northern highlands on the one hand, and the southern uplands on the other. Throughout this area the strata are arranged in a series of great basins with intervening ridges. The chief basins, beginning in the east, the basins of Fifeshire, and Midlothian being first; second, the Lanarkshire and Stirlingshire basin; third, the broken and interrupted basins of Ayrshire and the south. This system is capable of being divided into four great series, which, beginning at the top, are as follows:—(1) the Coal Measures, (2) the Millstone Grit, (3) the Carboniferous Limestone (4) the Calciferous Sandstone series.

From Prof. Geikie's review of the more characteristic features assumed by the Scottish Carboniferous system, it is evident that the series which diverge most from those that are typical of the English area are the Calciferous Sandstones and the overlying Carboniferous Limestone series. In England, the strata that underlie the Coal Measures and Millstone Grit are composed almost exclusively of beds which have been amassed upon a sea bottom. In Scotland, on the other hand, we find the strata upon which the true Coal Measures and Millstone Grit repose giving evidence of numerous interchanges of land, fresh or brackish water, and marine conditions; while at the same time we are assured that during the accumulation of these underlying strata the eruption of melted matter hardly ever ceased in central Scotland.

NOTES

THOSE interested in the early history of geology will be glad to learn that a work is announced as ready for publication, with the title, "A Book about William Smith and the Somersetshire Coal Canal; being an Account of the Commencement of Stratigraphical Geology in England." The book is illustrated by a series of consecutive photographs of the districts along the north side of the Canal valley, and each photograph is accompanied by a geologically coloured key, which shows at a glance the outcrop of the various strata. This method is, as far as we know, quite original, and serves to show clearly the data with which Smith dealt in arriving at his discoveries.

THE Vice-Chancellor of the University of Cambridge, in resigning his office, referred to the progress made by the University in encouraging new branches of study. He commented upon the extension of the influence of the University over the studies in the kingdom, and the increasing desire on the part of those engaged in the work of education to be brought more closely in contact with the University. The yearly increase in the number of candidates for the Middle-class Examinations, and the institution of an examination for the higher grade schools, evidenced the fact of the extending influence of the University. The Vice-Chancellor referred to the munificence of the Chancellor, the Duke of Devonshire, in providing a school for Experimental Physics, and congratulated the University upon the approaching completion of the building of the Fitzwilliam Museum. The acquisition of the Leckenby collection of fossils to the Woodwardian Museum was a worthy proof of the liberality of the Colleges and members of the University, as well as a graceful acknowledgement of the services of Prof. Sedgwick. The donations of Lord Walsingham and Miss Walcott were likewise valuable additions to the collections in the above-mentioned museum. Among other bequests and donations, the Vice-Chancellor particularly alluded to the bequests of Sir John Herschel and the Rev. R. E. Kerrich, and especially to the generosity of the Earl of Portsmouth in presenting the MSS. of Sir Isaac Newton.

THERE has been a marked increase during the present term in the University of Cambridge in the number of students who take advantage of the privilege of being allowed to reside out of their college. Since the scheme was established in 1869, eighty students have been admitted, a considerable number of whom devote themselves to the study of natural science. The University payments for nine terms' residence, including the B.A. degree, do not greatly exceed 30*l*., and even with books and additional instruction the amount need not be much over 50*l*. The number of freshmen entered at the University this year is 622, as compared with 572 last year.

DR. BROWN-SEQUARD, the eminent physiologist, has resigned the chair of Comparative and Experimental Pathology in the Faculty of Medicine in Paris, which he has occupied for several years. It is understood that this is preliminary to establishing his permanent residence in Boston, U.S.A.

AT a meeting of the Council of the Royal College of urgeons, held on October 31, Mr. John Birkett, F.R.C.S., urgeon to Guy's Hospital, was elected a member of the Court f Examiners, in room of Mr. George Busk, F.R.S., who lately esigned the presidency of the college. Mr. Birkett, who is a nember of several scientific societies at home and abroad, is lso Examiner in Surgery at the University of London.

Mr. Josiah Mason, of Birmingham, the founder of the Erdngton Orphanage and the Birmingham Science College, now in rocess of formation, has received, through Mr. Gladstone, an offer f knighthood from Her Majesty, in recognition of his munificence in the causes of charity and education.

A **Correspondent** of the *Times* describes an interesting *fête* given on Sunday, Oct. 27, by the Municipality of Florence on the occasion of the inauguration of the new Florentine Observatory, placed on a very striking eminence from which in former times Galileo made most of his discoveries. Donati, the great star of the stars of Florence, and who was to have been the president and great attraction of the *fête*, was prevented from attending, as he had the day previously so hurt his leg by a fall that he was confined to his bed. The Municipio of Florence, Peruzzi at their head, had provided a splendid buffet, or *dejeûner à la fourchette*, for the whole of the guests invited, the music was excellent, and the view from the Observatory superb.

We hear from Ceylon that there has been a deluge, which has done considerable damage; but the coffee districts are believed not to have suffered much. At Colombo a bank near the Pettah, or native suburb, had to be cut through in order to allow the water accumulated in the lake and its neighbourhood to escape into the sea. Mr. S. Green, of Colombo (a gentleman who takes great interest in science, and has sent home to England a great number of very interesting minute insects new to science, and who has a splendid telescope by Cooke, the best in Ceylon), says in a private letter:—"We have had heavy rains here, which have inundated a great portion of the Western Province. A great many native houses have been destroyed, and one or two lives lost. Many natives took refuge in the cocoa-nut trees around their dwellings; but some were found already occupied by snakes that had climbed the trees to escape the flood. They were very fierce, and maintained their position. A friend of mine going over the paddy-fields in a boat, saw several dead snakes floating on the water, and others swimming about."

The *British Medical Journal* informs us that among other improvements about to be carried out at the Medical School of the Charing Cross Hospital, a Demonstrator of Anatomy is shortly to be appointed, with the annual salary of 150*l*. Preerence will be given to gentlemen possessing a knowledge of Comparative Anatomy, as it is desired to associate a lectureship on this subject with the office of demonstrator.

The following lecture arrangements are announced at the Royal Institution for the coming season:—Six Lectureson Air and Gas, by Prof. Odling, F.R.S.; Twelve Lectures on the Three Lectures on Oxidation, by Dr. Debus, F.R.S.; Four Lectures on the Artificial Formation of Organic Substances, by Dr. H. E. Armstrong; Four Lectures on the Chemistry of Coal and its Products, by Prof. A. Vernon Harcourt, F.R.S.; Six Lectures on the Comparative Political Institutions of Different Nations, by Edward A. Freeman, D.C.L.; Three Lectures on the Philosophy of the Pure Sciences, by Prof. W. K. Clifford; Three Lectues on Darwin's Philosophy of Language, by Prof. Max Müller, LL.D. The Friday Evening Meetings will commence on January 17. Friday Evening Discourses will probably be given by Wm. Spottiswoode, F.R.S., the Rev. Prof. T. R. Birks, Edward Dannreuther, Esq., Robert Sabine, Sir H. Rawlinson, F.R.S., Prof. Clerk Maxwell, F.R.S., James Dewar, E. J. Reed, C.B., J. Emerson-Reynolds, Prof. W. K. Clifford Prof. Tyndall, F.R.S., Lord Lindsay, Prof. Odling, F.R.S. and others. After Easter:—Three Lectures on the Limits of the Historic Method, by John Morley; Four Lectures on the Evidence for the History of Rome from Existing Architectural Remains, by J. H. Parker, C.B.; Six Lectures by Prof. Tyndall, F.R.S.; Four Lectures by Prof. Odling, F.R.S.; Three Lectures on the Development of Music in connection with the Drama, by Edward Dannreuther. In January the New Laboratories for research will be open for the inspection of the Members of the Institution.

The following lectures are arranged to be delivered during the ensuing season at the London Institution, Finsbury Circus:—Educational Lectures, first course commencing Tuesday, Nov. 12; a lecture on the Nutrition of the Body, by Prof. Rutherford; second course commencing Jan. 27, 1873, eight lectures on Physical Geography, by Prof. Duncan, F.R.S.; third course commencing Monday, April 7, six lectures on Elementary Botany, by Prof. Bentley; two lectures on Fungoid Organisms in their relation to Mankind, by Prof. Thiselton Dyer, Mondays, March 24 and 31. Evening Lectures: Cavern Researches, by W. Pengelly, F.R.S.; Kent's Cavern, Torquay, Nov. 6; and The Cave Men of Mentone, Nov. 13; on Spontaneous Movements in Plants, by Alfred W. Bennett, Nov. 27; on the Paraffin Industry, by F. Field, F.R.S., Dec. 14; on Ancient Science, by G. J. Rodwell, Jan. 15, 1873; on Fresco and Siliceous Paintings, by Prof. Barff, Feb. 5 and 12; on the Result of recent Meteorological Inquiry, by Robt. H. Scott, F.R.S., Feb. 26. On Dec. 11, 1872, Mr. Austen will read a paper, to be followed by discussion, on Peat as a Substitute for Coal. Prof. H. E. Armstrong will deliver a holiday course of four lectures, adapted to a juvenile auditory, on Air, Earth, Fire, and Water, commencing Dec. 30th.

Mr. J. Jenner Weir, F.L.S., delivered a lecture last evening at the Crystal Palace, on the Aquarium and its Contents. The West Kent Microscopical Society exhibited their instruments on the occasion.

The following lectures will be delivered before the Bolton Literary and Scientific Society (Subject not fixed):—J. Glaisher, F.R.S., Nov. 19. On Coal and Coal Plants, by Prof. W. C. Williamson, F.R.S., Dec. 10. Where are the Bones of the Men who made the Flint Implements? by Wm. Pengelly, F.R.S. The Gulf Stream; what it does, and what it does not, by Dr. Wm. B. Carpenter, F.R.S., Feb. (day not fixed). An elementary course of six lectures on astronomy has been delivered by the Rev. J. Freeston; to be followed by one of eight lectures on geology and physical geography, by J. Collins.

The birth of a hippopotamus is again announced to have taken place at the Zoological Gardens, Regent's Park, on Tuesday last.

A **Mdlle. Jacobs** is mentioned in the Dutch papers as having successfully passed her examination in physics and mathematics at the University of Gröningen. This lady will be the first female medical student in the Netherlands.

Dr. Druitt, well known as an author of standard surgical works, as a leading labourer in the cause of sanitary progress, and as the Editor of the *Medical Times and Gazette*, is compelled by ill health to retire for two years to a more genial climate. At a meeting attended by many of the leading members of the profession on October 31, it was resolved to initiate a subscription with a view to the public recognition of his eminent services.

The Persian Government, the *School Board Chronicle* tells us, has engaged, through its representative at Paris, forty tutors fo a Lyceum to be established in Persia on the "model system" of France.

THE meeting of Abbe Moigno's *Salle du Progrès* of October 25 was so crowded that great numbers could not obtain admission. He commenced on Monday last a series of scientific *soirées*, which he hopes may prove permanent.

PROF. C. A. WHITE informs us that the report of his paper on the Geology of Iowa, read before the American Association for the Advancement of Science which we took from the *New York Tribune*, was incorrect in several particulars. There is no quartzite in the north-eastern part of the State, the Sioux quartzite occurring in the north-western corner; and the stoneless area of drift should have been stated at 13,000 to 14,000, instead of 20,000 square miles.

ON the night of July 8 last, the object-glass of the Equatoria of the Alleghany Observatory was stolen, as also a few eye-pieces belonging to the Transit. It is thought that the object of the thief is to try to extort a large reward for its return, but Mr. Langley, the director of the Observatory, has resolved not to offer a reward, nor guarantee immunity from punishment to the culprit. This he deems a duty to others who may have the charge of similar instruments.

THE fifty-sixth session of the members of the Institution of Civil Engineers will be commenced on Tuesday, November 12, and will be continued thereafter on each succeeding Tuesday, with the exception of a short interval at Christmas, till the end of May. During the recess, the premises occupied by the Institution in Great George Street, Westminster—which were rebuilt and greatly enlarged in 1868—have been elaborately decorated, especially the theatre, and additions have been made to the library. The members have been specially urged to contribute, for reading and discussion at the evening meetings, well-authenticated accounts descriptive of executed works in foreign countries, in which it is thought British engineering literature is at present somewhat deficient. With regard to candidates seeking admission into the Institution, the members of all classes have been reminded that personal knowledge of the career and antecedents of every candidate is requisite, and only such should be recommended for election as are believed to be in every way worthy of the distinction, and willing and able to advance the interests of the society.

AMONG Messrs. Longmans' announcements for the present season are the following:—Electricity and Magnetism, by Fleeming Jenkins, F.R.SS. L. and E. Professor of Engineering in the University of Edinburgh, small 8vo.; Geometric Turning, comprising a Description of the New Geometric Chuck constructed by Mr. Plant, with Directions for its Use, and a Series of Patterns cut by it, by H. S. Savory, 1 vol. 8vo., with numerous illustrations; Notes on the River Basins of the British Isles, by Robert A. Williams, 16mo.; Physical Geography for Beginners, by William Hughes, 18mo.; Catechism of Zoology, by the Rev. J. F. Blake, M.A., fcap. 8vo.; Popular Lectures on Scientific Subjects, by Prof. Helmholtz, translated by E. Atkinson, 1 vol. 8vo.; Introduction to Experimental Physics, by Prof. Adolf F. Weinhold, translated and edited by Benjamin Loewy, F.R.A.S., with a Preface by G. C. Foster, F.R.S., 1 vol. 8vo.; Handbook of Hardy Trees, Shrubs, and Herbaceous Plants, based on the French work of Messrs. Decaisne and Naudin, and including the original woodcuts by Riocreux and Leblanc, by W. B. Hemsley, 1 vol. 8vo.; A General System of Descriptive and Analytical Botany, translated from the French of E. Le Maout, M.D., and J. Decaisne, by Mrs. Hooker, edited and arranged according to the English botanical system, by J. D. Hooker, M.D., with 5,500 woodcuts, from designs by L. Stenheil and A. Riocreux, 1 vol. medium 8vo.

THE tenth part of the illustrated quarto publication upon the butterflies of North America, by Mr. William H. Edwards, has just made its appearance. This should have completed the first volume, but as better specimens have been obtained of several species heretofore figured, it is Mr. Edwards's intention to furnish these in a new supplemental number, with title-page and indices. This work, in addition to the numerous coloured figures and the elaborate descriptions of various species and their varieties, contains a synoptic list of North American butterflies, embracing 509 species, of which, previous to 1852, only 137 were known as belonging to North America. Sixty-one species were added between 1852 and 1860, and 311 since the latter year. There is every reason to believe that, with a thorough exploration of other regions of North America, many more will be found and added to this number.

THE formation in Manchester of a Society for Promoting Scientific Industry is advocated by Mr. Frank Spence, of the Pendleton Iron Works. He says, in a letter to the *Manchester Guardian*, that the proposed society "will deal only with science in its practical applications—in the selection and perfection of all the instruments of production, not excluding the most important, and, just now, to many a manufacturer, most embarrassing of them all, the worker." He refers, as a precedent, to the Société Industrielle de Mulhouse, organised, in 1825, for "the advancement and propagation of industry, by the assemblage in a central situation of a great number of the elements of instruction, by the communication of discoveries and of remarkable facts, as well as by the initiation of original investigations, and by all the means which shall suggest themselves to the members in order to insure its prosperity and the happy results to which it may give rise." This is an attempt at a movement in the right direction.

PROF. MARSH, having completed the determination of the new species of fossil mammals and birds obtained during the Yale College expeditions of the summers of 1870 and 1871, has begun upon the reptiles, and has described five new species of a new genus, which he calls *Thinosaurus*. These were large carnivorous lizards, resembling the *Varanidæ*, or monitors, but differing in certain features pointed out by the professor. They are all from the tertiary beds of Wyoming. Other species belong to two new genera, *Oreosaurus* and *Tinosaurus*, together with a new species of a genus, *Glytosaurus*, previously indicated.

DR. HOOKER states that the rainfall for October amounted, at the Royal Gardens, Kew, to 6·46 inches. Of this no less than 3·09 inches was recorded in the last seven days of the month. The rainfall for October registered at the Royal Botanic Gardens, Regent's Park, seven miles distant from Kew, was 5·25 inches.

Les Mondes describes a curious experiment of M. R. P. Lafond. Take a chameleon top, and place on the centre one of the prismatic discs which can be bought with the article, and instead of producing the singular optical illusions usually obtained from these discs by means of the fingers (in the same way as the "checked action" of Wheatstone is produced), illumine the table with a large Geissler tube. The result is described as charming; the most varied combinations of colours and designs succeed each other, without any necessity for touching the discs and consequently destroying the movement of the top. Moreover—and this makes the plaything a veritable scientific instrument—we have here a beautiful demonstration that the light of the Geissler tubes is intermittent.

Harper's Weekly announces the early publication of an important work on American Natural History—the investigation of the Cetaceans of the western coast of North America, by Capt. C. M. Scammon of the United States Revenue Marine. This gentleman has for many years been directing his attention to the subject, and has collected a large amount of material in reference to the various species of whales and porpoises of the western coast, together with their zoological peculiarities and their habits.

ATALOGUE OF BRIGHT LINES IN THE SPECTRUM OF THE SOLAR ATMOSPHERE*

VITHOUT waiting to complete my entire report of the spectroscopic work at Sherman, I send for immediate publicaon, should you think proper, a list of the bright lines observed the spectrum of the chromosphere during the past summer.

The great altitude of the station (nearly 8,300 ft.), and the onsequent atmospheric conditions, were attended with even eater advantages for my special work than had been really exected, although I was never quite able to realise my *hope* of eing all the Fraunhofer lines reversed; unless once or twice r a moment, during some unusual disturbances of the solar surce. Everything I saw, however, confirmed my belief that the rigin of the dark lines is at the base of the chromosphere, and at the ability to see them all reversed at any moment depends erely upon instrumental power and atmospheric conditions.

In this view, a catalogue of the bright lines actually observed of course less important than it would be otherwise; still it is ot without interest and scientific value, since the lines seen are aturally those which are really most conspicuous in the chroosphere spectrum, and this conspicuousness stands in important, ut by no means obvious or even entirely simple, relations to e intensity of the corresponding dark lines, when such exist. here can be no doubt that a careful study of these bright lines nd their behaviour would yield much valuable information as to he constitution and habitudes of the solar atmosphere.

In the catalogue, the first column contains simply a reference umber: a ‡ refers to a note at the end of the catalogue.

The numbers in the second column refer to my "Preliminary atalogue," containing 103 lines, which was published a year go in the *American Journal of Science*. In this column a † ndicates that some other observer has anticipated me in the etermination and publication of the line. As I have depended or my information almost solely upon the *Comptes Rendus* and the Proceedings of the Royal Society (which give the observations of Lockyer, Janssen, Rayet, and Secchi), it is quite possible that some other lines ought to be marked in the same manner.

The third column, headed K, gives the position of the lines on Kirchhoff's scale, the numbers above G being derived from Thalen's continuation of Kirchhoff's maps. In this column an asterisk denotes that the map shows no corresponding dark line, a ? that the exact position, not the existence, of the line is for some reason slightly uncertain.

The fourth column, headed A, gives the wave-length of the line in ten millionths of a millimetre according to Angström's atlas. The numbers in this and the preceding column were taken, not from the maps themselves, which present slight inaccuracies on account of the shrinking and swelling of the paper during the operation of printing, but from the numerical catalogues of Kirchhoff and Angström which accompany their respective atlases. In the preliminary catalogue the numbers were derived from the maps; hence some slight discrepancies in the tenths of division.

The fifth column, marked F, contains a rough estimate of the percentage of frequency with which the lines were seen during the six weeks of observation; and the sixth column, B, a similar estimate of their maximum brightness compared with that of the hydrogen line C.

The variations of brilliance, however, when the chromosphere was much disturbed, were so considerable and so sudden, that no very great weight can be assigned to the numbers given. Nor is it to be inferred that lines which have in the table the same index of brightness were always equally bright. On some occasions one set of lines would be particularly conspicuous, on others, another.

With two or three exceptions, indicated in the notes, no lines have been catalogued which were not seen on at least two different days. In the few cases where lines observed only on one occasion have been admitted to the list, the observations were at the time carefully verified by my assistant, Prof. Emerson, so as to place their correctness beyond a doubt. Many other lines were "glimpsed" at one time and another, but not seen steadily enough or long enough to admit of satisfactory determination.

The last column of the catalogue contains the symbols of the chemical elements corresponding to the respective lines. The materials at my disposal are the maps of Kirchhoff and Angström, Thalen's map of the portion of the solar spectrum above G, and "Watts's Index of Spectra." Since the positions of the lines in the latter work are given only to the nearest unit of "Angström's scale," I have marked the coincidences indicated by it with a (w), considering them less certain than those shown by the maps.

In addition to the elements before demonstrated to exist in the chromosphere, the following seem to be pretty positively indicated—sulphur, cerium, and strontium; and the following with a somewhat less degree of probability, zinc, erbium, and yttrium, lanthanum and didymium. There are some coincidences also with the spectra of oxygen, nitrogen, and bromine, but not enough, considering the total number of lines in the spectra of these elements, or of a character to warrant any conclusion. One line points to the presence of iridium or ruthenium, and only three lines are known in the whole spectrum of these metals. The reversal of the H's deserves also especial notice.

No one, of course, can fail to be struck with the number of cases in which lines have associated with them the symbols of two or more elements. The coincidences are too many and too close to be all the result of accident, as for instance in the case of iron and calcium, or iron and titanium.

Two explanations suggest themselves. The first, which seems rather the most probable, is that the metals operated upon by the observer who mapped their spectra, were not absolutely pure—either the iron contained traces of calcium and titanium, or *vice versâ*. If this supposition is excluded, then we seem to be driven to the conclusion that there is some such similarity between the molecules of the different metals as renders them susceptible of certain synchronous periods of vibrations—a resemblance, as regards the manner in which the molecules are built up out of the constituent atoms, sufficient to establish between them an important physical (and probably chemical) relationship. I have prefixed to the catalogue a table showing the number of lines of each substance, or combination of substances, observed in the chromosphere spectrum, omitting, however, oxygen, and nitrogen, and bromine, since with one exception (line 230), neither of them ever stands alone, or accounts for any lines not otherwise explained.

The instruments and methods of observation were the same as those employed in the construction of the Preliminary Catalogue. Telescope, $9\frac{4}{10}$ inches aperture—spectroscope automatic, with dispersive force of 12 prisms.

The approximate geographical position of Sherman is long. 1h. 53·2m. west of Washington, lat. 41° 07′; altitude above sea-level 8,280 feet; mean height of barometer about 22·1 inches.

Table showing the number of coincidences between the bright lines observed in the spectrum of the chromosphere, and those of the spectra of the chemical elements.

Fe, Ti, $S_{(w)}$	1	Ti, $S_{(w)}$	3	*Unknown.*	52	Total.
" Ba, $S_{(w)}$	1	" Ca,	2			
" $S_{(w)}$ $Zn_{(w)}$	1	" Mn,	1	Fe,	64	110
" Co, Ce,	1	" Ce,	1	Ti,	23	43
" Ni, $E_{(w)}$	1			Ca,	10	29
Ca, Cr, Ce,	1	" Sr,	1	Ba,	8	13
" Li, Zn,	1	" Zn,	1	$S_{(w)}$	7	14
Ti, Ba, $S_{(w)}$	1			Mn,	6	12
Ba, La, $E_{(w)}$	1	Ca, Cd,	1	Ce,	5	11
		" Ce,	1	H,	4	4
Fe, Ca,	10	Ca, Co,	1	Na,	4	6
" Ti,	9	" Cr,	1	Cr,	4	10
" Mn,	4	" Sr,	1	Mg,	3	4
" Cr,	3			Sr,	3	6
" Ni,	3	$S_{(w)}$ $E_{(w)}$	1	Zn,	3	9
" Ba,	2			$E_{(w)}$	2	9
" Zn,	2	Mn, Zn,	1	Ni,	2	6
" $E_{(w)}$	2			Co,	1	5
		Cr, $E_{(w)}$	1	Cu,	1	2
" Ce,	1			La,	1	3
" Co,	1	Ce, Co,	1	Ru, Ir,	1	1
" Mg,	1			Cd,		1
" Na,	1	Na, Cu,	1	Li,		1
" $S_{(w)}$	1					
" La,	1	lines marked with an *	14			

The numbers in the last column denote the whole number of times that the symbol of each element appears in the catalogue, either singly or combined with others.

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* Letter to the Superintendent of the U. S. Coast Survey, containing a Catalogue of Bright Lines in the Spectrum of the Solar Atmosphere, observed at Sherman, Wyoming Territory, U. S. A., during July and August, 1872; by Prof. C. A. Young, of Dartmouth College. Reprinted from advance sheets of the *American Journal of Science and Art*.

Catalogue of Bright Lines in the Spectrum of the Chromosphere.
1872.

No	PC.	K.	A.	F.	B.	E.
1‡	1†	534·0*	7055·?	100	12	
2	2†	654·3	6676·9	25	50	Fe, Ba($_w$)
3	3†	C.694·1	6561·8	100	100	H,
4		711·4	6515·5	15	4	
5	4	718·7	6496·0	18	5	Ba,
6		731·7	6461·7	5	2	Ca.
7	5	734·0	6453·8	10	6	
8		740·9	6438·1	5	2	Ca, Cd,
9‡	6	744·3	6429·9	20	4	
10		750·1	6415·6	5	2	
11		756·9	6399·0	5	2	Fe,
12		759·3	6392·6	5	1	Fe,
13		767·?*	6373·?	5	2	
14	7	768·?*	6371·?	5	3	
15		778·3	6346·1	10	4	Ruth, Ir,
16‡	8	823·5	6245·4	8	5	Fe,
17‡	9	827·6	6237·3	8	2	
18		830·2	6231·5	5	1	Fe,
19		836·5	6218·3	3	1	Ti,
20		839·2	6214·1	3	1	Ti,
21		845·7	6199·6	2	2	Fe,
22		849·7	6190·5	10	2	Fe,
23		859·7	6168·3	3	1	Ca,
24		863·9	6161·2	8	3	Ca,
25		870·9	6148·1	3	2	Fe, E($_w$)
26		871·4	6146·8	3	2	
27	10	874·3	6140·6	25	10	Ba,
28		876·5	6136·1	2	1	
29		877·0	6135·6	2	1	Fe,
30		884·9	6121·2	5	3	Ca, Co,
31		890·2	6109·9	2	1	Ba,
32		894·9	6101·7	3	2	Ca, Li, Zn($_w$)
33		903·1	6083·1	3	2	Ti,
34		912·1	6064·5	5	2	Fe, Ti,
35		933·8	6018·0	2	1	Ba,
36		949·4	5990·0	10	4	
37		992·0	5913·2	2	1	Fe,
38	11†	D$_1$1002·8	5895·0	50	30	Na,
39	12†	D$_2$1006·8	5889·0	50	30	Na,
40‡	†	1011·2	5883·0	2	1	Fe,
41‡	13†	D$_3$1016·5*	5874·9	100	90	
42		1031·8	5852·7	8	2	Ba,
43		1135·1	5708·3	1	1	Fe
44		1151·1	5687·2	2	1	Na,
45		1154·2	5683·5	5	3	
46		1155·8	5681·5	2	1	Na, Fe, N($_w$)
47		1165·7	5667·8	2	2	S($_w$)
48		1167·0	5666·0	1	1	
49		1170·6	5661·5	15	2	Fe, Tl, E($_w$)
50		1175·0	5656·7	8	3	S($_w$) N($_w$)
51		1176·6	5654·4	2	1	Fe,
52		1187·1	5640·2	1	1	S($_w$)
53		1189·3	5637·3	1	1	
54		1200·6	5623·2	2	1	Fe,
55		1207·3	5614·5	2	1	Fe,
56		1229·6	5587·6	2	2	Ca,
57		1231·3	5585·5	2	1	Fe,
58	14†	1274·2	5534·1	50	12	Ba, Fe, Sr,
59	15	1281·3	5525·9	40	5	Fe,
60		1287·5	5518·7	15	2	Ba,
61		1298·9	5505·8	2	1	Fe,
62		1303·5	5500·5	2	1	Fe, La,
63		1306·7	5496·6	2	1	Fe, E($_w$)
64		1320·6	5480·2	2	1	Ti, Sr,
65		1324·8	5475·9	1	1	Ni,
66		1328·7	5472·3	3	1	
67		1337·0	5462·3	1	1	Fe, N($_w$)
68	16	1343·5	5454·7	10	4	Fe,
69	17	1351·1	5445·9	10	4	Fe, Ti, Br($_w$)
70		1360·9	5435·4	5	2	Zn, Br($_w$)
71		1362·9	5433·0	2	2	Fe,
72‡	18	1364·3	5431·8	8	5	
73	19	1367·0	5428·8	8	3	Fe, Ti,
74	20	1372·1	5424·5	25	6	Ba, Ti, S($_w$)
75	21	1377·4	5417·9	5	2	Ti, Mn,
76		1380·5	5414·5	2	2	Fe,
77	22	1382·5	5412·4	4	2	Mn($_w$)
78		1384·7	5410·0	2	1	Fe, Ni,
79		1385·7	5409·0	2	2	Cr,
80		1389·4	5404·8	2	1	Fe,
81	23	1390·9	5403·1	5	3	Fe, Ti,
82		1394·2	5399·6	2	1	Mn,
83	24	1397·5	5396·1	4	2	Fe, Ti,
84		1401·6	5392·2	2	1	Fe, Ce,
85		1412·5	5380·2	3	2	Ti,
86	25†	1421·5	5370·5	10	3	Fe,
87		1423·0	5369·0	1	1	Fe,
88		1425·4	5366·5	1	1	Fe,
89		1428·2	5364·0	1	1	Fe,
90	26†	1430·1	5361·9	20	10	Fe,
91		1438·9	5352·4	4	2	Fe, Co, Ce,
92		1446·7	5345·0	1	1	
93		1450·8	5340·2	1	2	Fe, Mn, O($_w$)
94	27	1454·7	5335·9	5	2	Ti, Zn($_w$)
95		1461·5	5329·1	6	4	
96	28	1462·8	5327·1	5	2	Fe,
97	29	1463·3	5327·6	5	2	Fe,
98		1464·8	5325·1	6	2	
99		1471·9*	5318·0	1	1	
100‡	31†	1473·9	5315·9	90	50	Fe,? O($_w$)?
101		1476·8	5313·1	3	1	
102		1497·3	5292·0	1	1	Cu, Br($_w$)
103	32	1505·3	5283·4	20	10	Ti($_w$)
104	33†	1515·5	5275·0	30	15	
105	34	E$_1$1522·7	5269·5	15	4	Fe, Ca,
106	35	E$_2$1523·7	5268·5	12	3	Fe,
107	36†	1527·7	5265·8	10	4	Fe, Co,
108		1530·2	5263·3	1	1	Ca, Br($_w$)
109		1538·5*	5256·2	2	1	Sr,
110		1541·9	5254·1	1	2	Fe, Mn,
111		1547·7	5249·7	3	1	Fe, Z($_w$) Br($_w$)
112		1551·6	5246·3	3	1	Fe,
113	37	1561·0	5239·0	4	2	Fe,
114	38	1564·2	5236·3	4	2	
115	39†	1567·5	5233·6	10	8	Mn, Zn($_w$)
116	40	1569·6	5232·1	1	3	Fe,
117		1575·4	5227·5	1	1	Sr,?
118	41	1577·4	5226·2	10	3	Fe,
119		1578·1	5225·5	2	3	Sr, Br($_w$)
120	42	1580·1	5224·3	2	2	Ti,
121		1589·1	5216·5	2	1	Fe,
122		1590·7	5215·5	3	2	Fe,
123		1592·3	5214·4	2	1	Fe,
124		1597·9*	5210·5	1	1	
125		1598·9	5209·5	1	2	Ti,
126	43	1601·5	5207·6	10	6	Fe, Cr,
127	44	1604·4	5205·2	10	6	Cr, E($_w$)
128	45	1606·4	5203·7	10	6	Cr, Fe,
129	46	1609·2	5201·5	5	3	Fe,
130	47	1611·3	5199·7	4	2	S($_w$) E($_w$)
131		1613·9	5197·9	1	1	Fe,
132	48†	1615·6	5197·0	15	10	
133		1617·4	5195·0	1	1	Mn,
134		1618·9	5194·1	2	2	Fe,
135		1627·2	5188·2	10	5	Fe, Ca,
136		1628·2	5187·3	1	1	Ti,
137		1631·5	5185·1	5	2	Fe, Ti,
138	49†	b$_1$1634·1	5183·0	50	30	Mg,
139	50†	b$_2$1648·8	5172·0	50	35	Mg,
140	51†	b$_3$1653·7	5168·3	40	30	Fe, Ni, Br($_w$)
141	52†	b$_4$1655·6	5166·7	30	20	Fe, Mg,
142		1666·?	5160·?	1	1	
143		1671·5	5154·8	3	1	Na,
144	53	1673·7	5152·5	3	1	Na, Cu,?
145	34	1677·9	5150·1	2	2	Fe, Br($_w$)
146		1689·5	5142·2	1	2	S($_w$)
147		1701·8	5133·0	1	1	Fe,
148		1704·7	5130·8	1	1	Fe,
149		1707·9	5128·6	1	1	Ti,
150		1710·7	5126·7	1	1	Fe, Ti,
151		1712·2	5125·5	1	2	
152‡		1713·4	5124·4	1	1	Fe,

o.	PC.	K.	A.	F.	B.	E.
53		1715·2	5123·2	1	1	Fe,
54		1717·9	5121·0	1	1	Fe,
55		1719·4	5119·9	1	1	Ti,
56‡		1727·3	5114·9	1	1	Ni,
57		1734·6	5108·8	2	2	Ti($_w$)
58		1737·7	5107·0	1	1	Fe,
59		1750·4	5098·1	1	1	Fe,
60		1752·8	5096·5	1	1	Fe, S($_w$)
61		1765·0*	5087·0	2	1	E($_w$)
62		1771·5	5083·5	1	1	Zn($_w$)
63	55	1778·5	5077·9	1	2	Fe,
64		1823·6	5047·8	2	2	Fe,? Zn($_w$)
65		1833·4	5041·2	2	2	Fe, Ca,
66		1834·3	5040·1	2	2	Fe,
67		1848·9	5030·1	4	3	S($_w$)
68		1856·9	5023·5	3	1	S($_w$)
69	56†	1867·1	5017·6	30	15	Fe, Ni,
170	57†	1870·6	5015·0	30	10	Ti($_w$)
171		1905·1	4993·3	2	1	Fe, N($_w$)
172‡		c.1961·0	4956·7	1	2	Fe,
173	58†	1989·5	4933·4	30	8	Ba,
174	59†	2001·6	4923·1	40	12	Fe, S($_w$) Zn($_w$)
175	60†	2003·2	4921·3	30	8	S($_w$)
176	61	2007·2	4918·2	20	3	Fe,
177		2016·0	4911·2	3	2	Zn($_w$)
178	62†	2031·1	4899·3	30	6	Ba, La, E($_w$)
179	63†	2052·5?*	4882·9	10	4	Ce,
180		2067·8	4869·4	5	1	
181	64†	F$_1$2080·0	4860·6	100	80	H,
182		2087·6	4854·7	5	2	Fe, Ni, E($_w$)
183		2094·0	4848·1	3	2	Ca, O($_w$)
184		2116·?*	4826·5	1	1	
185		2121·2	4822·8	10	2	Mn,
186		2142·4	4804·4	3	1	Ti, S($_w$) O($_w$)
187		2171·5	4778·7	3	2	Co, N($_w$)
188		2229·1	4730·8	1	1	Fe,
189‡		2251·3*	4712·5	2	2	Ce, O($_w$)
190		2309·5	4666·3	3	1	Fe, Ti,
191		2314·3	4663·3	2	1	
192		2323·0	4656·0	2	1	Ti,
193	65	2358·4	4629·0	15	8	Ti, N($_w$)
194		2359·5*	4628·2	2	1	Ce,
195		2369·7	4620·3	1	1	
196		2410·2	4589·4	1	1	
197		2412·8	4587·5	2	2	
198	66	2419·3	4583·2	15	6	
199		2429·5	4576·0	4	2	
200	67	2435·5	4571·4	10	4	Ti,
201	68	2443·9	4564·8	10	3	
202	69	2446·6	4563·2	10	5	Ti.
203		2452·1	4559·5	8	2	
204		2454·1	4558·1	8	1	
205	70	2457·9	4555·3	10	5	Fe, Ti,
206	71	2461·2	4553·4	10	5	Ba,
207		2463·4	4551·8	1	1	Ti, S($_w$)
208	72	2467·6	4548·9	10	8	Ti,
209		2480·8	4539·2	2	1	Ce,
210	73	2486·6	4535·5	2	2	Ti, Ca,
211	74	2489·4	4533·2	5	5	Fe,
212		2490·5	4532·1	3	2	Ti, Ca,
213	76	2502·2	4524·4	3	2	Ba, Fe,
214	77	2505·6	4522·0	3	3	Ti, S($_w$)
215		2517·0	4514·0	2	1	
216		2518·4	4513·0	1	1	
217		2527·0	4506·0	2	1	
218	78	2537·1	4500·3	15	6	Ti,
219	79	2552·4	4490·9	20	8	Mn,
220	80	2555·0	4489·4	15	3	Fe, Mn,
221	81	2566·3	4480·9	5	2	Mg,
222‡	82†	f.2581·2	4471·2	100	25	Ce,
223	83	2585·4	4468·5	20	5	Ti, O($_w$)
224		2620·8	4446·3	1	1	Ti,
225	84	2625·2	4443·0	10	2	Ti,
226		2633·0	4436·7	1	1	Mn?
227		2639·6	4433·5	1	1	
228		2651·5*	4426·0	2	3	
229		2653·2	4425·0	2	2	Ca,
230		2664·9	4418·0	2	1	O($_w$)

No.	PC.	K.	A.	F.	B.	E.
231		2665·9	4417·5	3	1	Ti,
232	85	2670·0	4414·7	1	1	Fe, Mn, O($_w$)
233		2680·0	4407·7	1	1	Fe, Ca,
234		2686·8	4404·2	1	1	Fe,
235		2696·0	4398·5	1	1	Ti, Ce, O($_w$)
236		2698·2	4396·5	1	2	
237	87	2702·5	4394·6	15	3	
238		2715·2	4388·5	1	1	Fe,
239	88	2718·5	4384·7	8	2	Ca, Ce,
240		2720·2	4383·5	1	1	
241	89	2721·6	4382·8	1	1	Fe, Cr,
242		2725·8	4380·4	1	1	
243		2728·0	4379·1	1	1	Ca,
244	90	2733·7	4375·5	5	3	Fe,
245	91	2736·9	4374·2	8	3	E($_w$)
246		2762·0	4359·1	1	1	Cr,
247	92	2775·7	4351·8	3	1	Cr,
248	93†	2795·7	4340·1	100	65	H,
249		2798·0	4338·2	10	2	Cr,
250		2805·4	4335·1	2	1	La,
251		2823·4	4324·0	1	2	
252		2830·7	4320·1	1	1	Ti, O($_w$)
253		2843·0	4313·5	1	1	Ti.
254	94	G.2854·2	4307·2	3	2	Ca, Fe,
255	95	2867·7	4302·1	3	2	Ca, Fe,
256	96	2874·2	4298·0	1	1	Ca, Fe,
257	97	2894·5	4289·4	1	1	Cr, Ca, Ce($_w$)
258	98	2928·5	4274·6	2	1	Cr, Ca,
259	99	2961·2	4260·0	2	1	Fe,
260	100	2996·2	4245·2	30	3	Fe,
261		3018·0	4235·5	30	5	Fe,
262		3022·8	4233·0	15	5	Fe, Ca,
263	101	3040·0	4226·3	3	3	Ca, Sr,
264	102	3061·8	4215·3	40	7	Ca, Sr,
265		3155·5	4178·8	1	1	
266		3187·0	4166·7	1	1	Ca,
267	103†	h. 3363·5	4101·2	100	50	H,
268		3431·0	4077·0	25	2	Ca,
269		3526·0	4045·0	3	2	Fe,
270		3703·3	3990·?	2	1	
271		3769·5	3970·?	2	1	Fe,
272‡		H$_1$3778·5	3967·9	75	3	Fe, Ca,
273‡		H$_2$3882·5	3932·8	50	1	Fe, Ca,

Notes

1. The position assigned to this line, first observed by Respighi (a fact of which I was ignorant when the Preliminary Catalogue was published), rests upon two series of micrometric measurements, referring it to four neighbouring dark lines—the probable error is about $\frac{1}{20}$th of a division of Kirchhoff's scale.

9. No. 6 in P C. Position there given, 743?

16 and 17. Nos. 8 and 9 of P C. Position given as 816·8 and 827·6, by a mistake in identifying lines upon the map.

40. I have never myself seen this line reversed. Prof. Emerson, however, saw it several times. It was first reported by Rev. S. J. Perry, in NATURE, vol. iii. p. 67.

41. The position of this line has been independently determined by three series of micrometric comparisons with neighbouring lines. My result agrees exactly with that of Huggins.

72. Erroneously given in P C, as 1363·1, which line does not reverse, or at least was never seen reversed at Sherman.

100. The principal line in the spectrum of the corona. The corresponding line in the spectrum of iron is rather feeble, and on several occasions when the neighbouring lines of iron (1463, &c.) have been greatly disturbed, this has wholly failed to sympathise. Hence I have marked the Fe with a ?. Watts indicates a strong line of oxygen at 5315 A.

152 and 156. Observed only on one day, but verified by Prof. Emerson.

172. Called little C by Mr. Stoney.

179. Given by Lockyer as K 2054. Its position is a little uncertain; it seems to coincide with neither of the dark lines at 2051 and 2054, but lies between them, a little nearer to 2051.

189. Rather a band than a line.

222. The position of this line, which, however, like 189, is rather a band, was determined by two series of careful micrometrical measurements.

It was first discovered in 1869 by Rayet, and has since been named "f" by Lorenzoni, who, ignorant of the previous work of several other observers, has claimed its discovery.

272 and 273. These lines were both reversed (by a narrow bright stripe running down the centre of the broad hazy band) as constantly, whenever the seeing was good, as *h* or C itself. The observation was difficult, however, and required the most scrupulous exclusion of foreign light, and a careful adjustment of the slit in the plane of the solar image formed by these particular rays.

They were also found to be regularly reversed upon the body of the sun itself, in the *penumbra and immediate neighbourhood of every important spot.*

SOCIETIES AND ACADEMIES

CAMBRIDGE

Philosophical Society, Oct. 18.—The following were elected officers of the Society:—President: Prof. Humphry. Vice-Presidents: Prof. Cayley, Prof. Adams, Prof. Liveing. Treasurer: Dr. Campion. Secretaries, Messrs. Bonney, J. W. Clark, and Trotter. New Members of Council: Prof. Babington, Prof. Stokes, Mr. Hort, Dr. M. Foster. The following communications were made to the Society:—"On the form suggested by M. Tresca, and adopted by the Commission Internationale du système métrique, for the Mètres Internationaux," by Prof. Miller, F.R.S. "A Method for Drawing in Perspective;" and "A Method for Levelling" (communicated), by Mr. J. C. W. Ellis. The nature of these papers does not admit of a brief abstract.

PARIS

Academy of Sciences, October 21.—M. Faye, president. In opening the meeting the President announced the death on that morning of M. Babinet, Member of the Academy, Physical Section.—M. Yvon Villarceau then read a note relative to a letter from M. Magnac on the use of chronometers at sea which he presented to the Academy. The note and letter related to the compensation and rating of chronometers, and in conclusion drew attention to the great and continuous care which ought to be devoted to this subject by the Transit of Venus Expedition of 1874.—M. Pasteur then read an answer to M. Fremy's two notes read at the meeting of the 7th October. M. Pasteur's observations were in support of his theory of the wine ferment coming from the husk of the grape. He concluded his observation as follows:—"I declare both the theory of the transformation of albuminous matters into ferment cells by contact with atmospheric oxygen, and that of hemeorganism, or the generation of ferment cells from fruit cells, to be erroneous."—Next came a vigorous reply from M. Chevreul to certain "allegations contained in a report, by M. A. Gruyer, on the International Exhibition of London, 1871." At the conclusion of the reply MM. E. Bequerel and Milne-Edwards made some remarks on the subject, when the matter dropped.—A note from M. R. Clausius, on the mechanical equation from which the 'viriel' theorem results was then read, and was followed by a note from M. A. de Caligny on the theory of the several systems of navigation locks, a long paper relating to various kinds of locks, sluices, floodgates, &c.—This was followed by the continuation of M. P. A. Favre and C. A. Valson's paper on crystalline dissociation. The authors find that potassium and ammonium alum are partially dissociated when rendered anhydrous, and that chromium-potassium alum, when rendered anhydrous and then washed, loses potassic sulphate. They also attribute the change from violet to green of solutions of chrome alum, when heated, to this cause, and state that there is nothing to prove that this is not the case with all alums.—M. C. Sédillot then presented a note on the phenomena of fermentation and their connection with pathological physiology. The note related to certain recent studies on zymology by M. F. Monoyer.—M. Tresca then asked the Academy to open a sealed packet deposited by him with it on September 9, 1870, and which contained the particulars of the secret place where he and General Morin had deposited the standard metre and kilogramme during the events of that time. He wished the Academy to open the depositary, and to place the standards in the hands of the Government.—M. Ed. Bureau then read a note on the value of characteristics deduced from the structure of the stem for the classification of the *Bignoniaceæ*.—The concluding portion of M. Max Marie's paper on the extension of the method of Cauchy to the study of double integrals, &c., followed.—A note from Ed. Jannettaz on the coloured rings produced in gypsum by pressure, and their connection with the ellipsoid of thermal conduction and with cleavage, was referred to the physical section, and M. C. Dareste's studies on the osteological types of osseous fishes was sent to the section of zoology. The commission for the Montyon prize for medicine and surgery received a memoir on the three "psoric acariens" of the Horse by M. P. J. Mégnin.—A communication from MM. Chevallier on the manufacture of amorphous phosphorous matches was sent to the commission on the unhealthy arts.—A suggestion for the use of the tension of liquid ammonia as a source of motive power in aerial navigation by M. Pollard was submitted to the commission on aerostation; and the *Phylloxera* commission received a note relative to a remedy for that pest from M. Chatelain.—M. Yvon Villarceau then communicated a letter on the elements and co-ordinates of the planet No. 123 from M. Stephan, and also an extract from a letter from M. de Magnac on the determination of longitude by chronometers.—M. Chasles presented a note from M. H. G. Zeuthen on quartic equations, of which one part is reduced to a direct double.—A letter from M. P. Volpicelli on the probable nature of the Saturnian rings, and on a meteor observed at Rome on the 31st of August, was then read.—M. Th. du Moncel read a note on the accidental currents which arise in telegraphic wires, one end of which remains isolated in the air, after which M. Pasteur presented a note, by M. Feltz, on the action of crystallisable sugar on Barreswil's cupro-tartaric reagent. The author's experiments tend to show that cane sugar acts on the reagent in the presence of an excess of alkali; hence he distrusts all determinations made where both sugars are present. This paper was followed by a note from MM. Béchamp and Estor on the rôle of the microzymes during embryonic development.—M. Tarry then read a note on the aurora and magnetic storm of the 14th and 15th October.—M. E. Fournié demanded the opening of a sealed packet relating to cerebral physiology deposited by him on the 22nd of July, 1872, and after a note from M. G. Bandiera on a means of separating essence of citron from turpentine had been submitted to M. Dumas, the session adjourned.

BOOKS RECEIVED.

ENGLISH.—The Expressions of the Emotions in Man and Animals. C. Darwin (Murray).—The Causation of Sleep: James Capper, M.D. (The Edinboro').—Underground Treasures; how and where to find them: James Orton (Worthington and Co.).

FOREIGN.—(Through Williams and Norgate.)—Ueber die Auflösung der Arten durch natürliche Zuchtwahl.—Ueber die Bedeutung der Entwickelung in der Naturgeschichte: Dr. A. Braun.—Sachs-register zu dem Repertorium: J. Schotte.

DIARY

THURSDAY, NOVEMBER 7.

LINNEAN SOCIETY, at 8.—On the "Piopio" of New Zealand (*Keropia crassirostris Gmel*): T. H. Potts.—On the buds developed on leaves of *Malaxis*: George Dickie, M.D.

SUNDAY, NOVEMBER 10.

SUNDAY LECTURE SOCIETY, at 4.—On A Bar of Iron: John Hopkinson, D.Sc.

TUESDAY, NOVEMBER 12.

LONDON INSTITUTION, at 4.—On Nutrition: Prof. Rutherford. (Educational course.)

THURSDAY, NOVEMBER 14.

LONDON MATHEMATICAL SOCIETY, at 8.—Remarks on some Recent Generalisations of Algebra: the President.—Sur les Fonctions Circulaires: M. Hermite.—Investigation of the Disturbance produced by a Spherical Obstacle on the Waves of Sound: Hon. J. W. Strutt.—On the Mechanical Description of a Cubic Curve: Prof. Cayley.—A Series of Models of Cubic Surfaces to Illustrate their Different Forms: Prof. Henrici.

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THURSDAY, NOVEMBER 14, 1872

EXPLORATION OF THE SOUTH POLAR REGIONS

IN the various explorations which the last few years have seen, it must be admitted that the South Pole has been neglected, and its rival, the North Pole, has had it all its own way. It is not to be wondered at, therefore, that Dr. Neumayer, with whom the Exploration of the South Polar regions has been a cherished project from his youth, and who for many years has lived in the hope of some day having the privilege granted him of taking part in an expedition on board a German ship that might have the honour of penetrating the South-Polar circle, and clearing up the mystery that lies beyond, will allow this state of things to continue without protest. Since this hope has been time after time frustrated, and because he fears that now it may never be realised, he is determined to do what he can to rouse an active interest in the subject among scientific men. By lectures in various parts of Germany, and otherwise, he endeavoured some little time ago to set afoot an exploring party, whose observations might have been of great use in connection with the now not very distant Transit of Venus, but in this, too, he failed; so that now there remains only the hope that, in connection with the scientific expeditions to the south for the observation of that momentous astronomical event, something may be done towards the realisation of the "darling scheme of his youth." Hence, to awaken a general interest in antarctic explorations, as well as to show what remains to be done, Dr. Neumayer has reprinted, in the form of a pamphlet, a long article of his from the "Zeitschrift der Gesellschaft für Erdkünde," on the subject, referring to his numerous lectures and writings on the subject, and has given a brief sketch of the progress of discovery in the South Polar regions, and an admirable summary of the points to which any expedition should direct its attention—to which, anxious to second his efforts, we gladly draw attention.

Of maritime expeditions, those to the Polar regions have had a lasting interest for geographers, both as leading to the solution of important scientific problems, and as being of value from a more material point of view. The importance of scientific observation inside the Polar circle is evident, Dr. Neumayer declares, to all who have any knowledge of the phenomena on the surface of the globe. Without such observations there exists a void and a lamentable one-sidedness in our knowledge, offering a fertile field for numberless, and mostly worthless, hypotheses. What have been the results of efficient observation in the far north for the confirmation and correction of our knowledge in the departments of magnetism, climatology, the geographical distribution of plants and animals, the laws of ocean currents, is shown by a superficial glance at the history of the development of these departments of science. But Dr. Neumayer maintains that for the purpose of discovering those general laws which are necessary as guides and standards in the interpretation of phenomena in climatology and physical geography generally, the South Polar regions are much better adapted than those of the North. A glance at the globe, he maintains, shows that such results can be obtained only by the expenditure of vast means and laborious research in the north, on account of the nature of the division of the land and water, which also throws difficulties in the way of a satisfactory study of the phenomena; whereas no such difficulties and disturbances are presented by the prevailing sea of the South Polar regions. These statements could be proved by many examples from physical geography, but it is only necessary to refer to the valuable additions which have been made by researches in high south latitudes to our knowledge of the laws of the relation between the distribution of the pressure of the air and of heat, and of the laws of winds. Moreover, Dr. Neumayer maintains that very valuable light would be thrown on the laws of the distribution of living organisms by explorations in this quarter, where there is scarcely any land but a few scattered islands.

Dr. Neumayer then proceeds to give a sketch of the history of discovery in the South Polar regions, dividing it into three periods. The first of these periods begins with the sixteenth century, and ends with the determination of the south point of America by Schoelten and Lemaine in 1616. The second period extends to the beginning of the present century, and the third from that time onwards.

The voyages embraced in the first period were not Polar voyages in the strict sense, for no one stepped over the Polar circle, and their main object was to fix the route to India and the Spanish colonies on the west coast of South America. The expeditions which went south during the second period had for their purpose to discover and fix the limits of the great southern continent which theoretical geographers supposed must exist in those regions in order that the balance of land might be maintained. The expeditions which have gone out to this quarter during the present century have had for their purpose mainly the observation of phenomena for scientific purposes.

Of the great voyagers belonging to the first period, it can hardly be said that any made discoveries in what is generally considered the Antarctic region. Sebald de West, in January 1600, saw a group of islands in 50° 40′ S. and 59° W., which were called Sebald's Islands, and which were possibly the same as the Falkland Islands, whose proper discovery falls to a later time. One of the minor voyagers of this period, Dick Gerritz, discovered an island group in 61° S. lat. and seems to have reached 64°. This ice-bound group was probably the same as that now called South Shetland, although it is possible Gerritz had seen Palmer's Land. During this period discoveries only reached the higher latitudes south of Cape Horn; in other circumpolar parts the 40th parallel had only been reached at the Cape of Good Hope; and in the Indian Ocean, on the way to Batavia, the islands of St. Paul and New Amsterdam were already known in the beginning of the 17th century.

The earliest of the discoveries of the second period were those of the famous Abel Tasman. The maps of Mercator in 1628 attach the north coast of New Holland to the great continent of Australasia, that spreads itself all over the South Polar region, and annexes the discoveries of Dick Gerritz to South America. The unrestrained fancy of the geographers of the time even leads them to set down a continuation of the Cordilleras as running through the "great south continent." This delusion Tasman destroyed, when, in the year 1642, he sailed round the south of New Holland, and discovered Van Diemen's Land; he also discovered the west coast of New Zealand. La Roche, in 1675, discovered South Georgia; while the Malouins (1700-1712) place the Falkland Islands accurately on the maps. The voyages of Hay and Lozier Bonnet circumscribed considerably the extent of the south continent in the Atlantic and Indian Oceans; but through the discovery of Cape Circumcision in about 52° S. lat. and 10° E. long., it was believed a new proof of its existence had been gained.

Dr. Neumayer pays a very high tribute to Cook for the restless energy with which he pursued his work, and the vast and valuable additions he made to the then scanty knowledge of these southern regions. The maps of 1762 have still the south continent prodigally displayed, reaching as far as 20° S. into the Pacific itself; the maps of 1775 show not a trace of it, although, even so late as 1773, Kerguelen believed he had seen it in lat. 49° S. and long. 70° E.; what he saw was Kerguelen Island. It was Cook who had the honour of proving that the "Great South Continent" was a mere chimera.

In March 1770, after the observation of the transit of Venus, he found New Zealand to be an island. On his second voyage he passed to the south of Kerguelen Island in February 1773, though he appears not to have seen it showing there was no hope for theoretical geographers in, this direction. In the previous month, January 17, he passed the South Polar circle in E. long. 39° 30′—the first time the feat had been performed by any explorer—sailing as far south as 67° 15′. In the (southern) summer of 1773-4 Cook explored the ocean from 175° to 98° W. long., and between 50° and 71° 10′ S. lat., thus clearly proving the non-existence of a great continent to the South Pacific. In December 1774 he sailed from New Zealand to Magellan's Straits, to convince himself that there was no sign of the supposed continent between 55° and 56° S. lat. There he re-discovered the island of St. Pierre, seen by Duclos Guyot in 1756, and a century earlier by La Roche, and named it South Georgia. On his return he discovered the Sandwich group, and narrowly missed the South Orkney and South Shetland Islands. Cook set out on his third great voyage of discovery in January 1777, intending to lay down the exact position of Prince Edward's and Kerguelen Islands, and make observations on the physical geography of the latter; but ere he could accomplish his aim "this greatest of all discoverers of the 18th century" met his sad death in February 1779.

A comparison of the maps of 1762 and 1785 will suffice to show how much was accomplished by Cook. The chief conclusion come to by the great navigator as the result of his extensive explorations was, that outside of the South Polar circle no stretch of land of any extent could be found, and that if any such existed inside the Antarctic zone, for all productive purposes, indeed even for the sustenance and development of organic life, it was useless. The labours of Cook gave thus a negative result; it remained to future voyagers to prove whether any continent existed *within* the Polar circle.

In the third period, that from the beginning of the present century, we have to do with expeditions, which, inside or in the close neighbourhood of the South Polar circle, have sailed through and explored great stretches of ocean, and examined the coasts and islands of the Polar zone. It is the explorers of this period who have contributed so largely to our knowledge of the physical geography of the Antarctic regions.

In October 1808 Captain Lindsay saw the Bonnet Group, and in February 1819 Smith re-discovered Gerritz or Gerrard's Islands, now known as the South Shetlands. We are indebted for much of our knowledge of the regions south of Cape Horn to the zeal of the American whale and seal fishers, Powell, Palmer, Pendelton, Fanning, and others. To these we owe the discovery of Palmer's Land and the South Orkneys. All agree in describing these lands as wholly bound in ice, almost always enveloped in dense fogs, and showing scarcely a sprig of vegetation. Here and there from out the mass of ice projects a black peak, which, even at a distance, by its showing no trace of the otherwise universal ice, proclaims itself of a volcanic nature. Numberless birds nestle on these islands, on which no quadrupeds have yet been found; and on the warm sides of the volcanic cones nothing is to be found but multitudes of living penguins, who use them as resting-places. In the surrounding sea is a rich vegetable life, on which the seals and fishes appear to thrive.

The re-discovery of the South Shetland Islands gave a new impulse to Antarctic exploration, in behalf of which an active interest now began to show itself in Europe. The Russian Empire took the lead, and in July 1819 sent out two ships, the *Wostok* and the *Merny*, under the command of Captains Bellinghausen and Lazaren, who distinguished themselves by their pluck and circumspection. They sailed round and defined South Georgia, and Bellinghausen endeavoured, under the meridian of Greenwich, to get as near the Pole as possible. However, after working his way with great difficulty as far south as 69° 25′ (1° 11′ W.), the impossibility of penetrating farther through the immense masses of ice compelled him to turn northwards. Another attempt under 18° E. long. was also in vain, and the advanced season compelled the ships to return to Port Jackson. The expedition set out again in November; and on January 22, 1821, in 92° 19′ W. long., reached 69° 33′ S. lat., not far from the *ne plus ultra* of Cook. On the same day, in 68° 27′ S. lat., 90° 45′ W. long., Bellinghausen saw an island 4,200 ft. high, which he named "Peter the Great Island;" and on the 29th, in 68° 43′ 20″ S. lat., 73° 9′ 36″ W. long., he saw land of great height, which appeared to him to be a cape belonging to a large continent. This he named "Alexander Land." The land was completely locked in ice, and in the sea itself all life appeared to be extinct. At the South Shetlands Bellinghausen fell in with Captain Palmer, who told him of his discovery of Palmer's Land.

The voyages of these Russian explorers, who returned home in the middle of the year 1821, were undoubtedly, as South Polar explorations, the most important which had hitherto been undertaken. They almost circumnavigated the Pole at an average distance of 30°, explored a larger tract inside the Polar circle than ever had been done before, and discovered the first Polar land. Moreover, they completed a series of valuable hydrographical researches, and it is to be lamented that these are still inaccessible to all who are unacquainted with the Russian language.

The next important expedition after the Russian one was that of Captain Weddell, during the years 1822-24, whose observations Dr. Neumayer considers perfectly trustworthy and very valuable, notwithstanding the aspersions of a subsequent explorer, Dumont d'Urville, whose own expedition was resultless. Weddell's labours embrace valuable materials on currents, the variation of the compasses, and nautical and meteorological matters. What is of great interest, is his voyage to a high south latitude in January and February 1823. With his two little vessels, the *Jane*, of 160 tons, and the *Beaufoy*, of 65 tons, he made his way from the South Orkneys between great masses of ice, and reached, on the 20th February, in 33° 20′ W. long., to 74° 15′ S. lat., the highest which had hitherto been attained. He found the sea here so free from ice, that he named it "George IV. Sea," and expressed his belief that it would be an easy matter to approach much nearer to the South Pole. Having convinced himself that no land of any importance existed in this direction, he turned northwards.

In 1829 Captain Henry Foster was sent out by the British Government for the purpose of making observations on the physical geography of these regions. He fixed his quarters at Pendulum Bay, on the island of Deception, whose east end was fixed by Weddell at 63° 2′ S. lat., and 60° 45′ W. long. Foster stayed here from Jan. 10 to March 6, and carried on a series of valuable hydrographical observations. Among other things he determined the length of the simple seconds pendulum. Before his departure he fixed in an exposed position a self-registering maximum and minimum thermometer, which in the year 1842 was found by Captain Smiles, who found the minimum temperature during 13 years to have been -20·5° Cent. Unfortunately the index of the maximum thermometer had got out of order and could not be read.

Captain Biscoe, with two small ships, the *Tula* and the *Lively*, went out in the year 1830. The highest latitude reached by him was 68° 51′ S., under 12° 22′ E. long. On the 16th of March, 1831, he found Enderby's Land, and on February 15, 1832, he discovered Adelaide Island, one of a series which runs in a westerly direction, each of which bears the name of its discoverer. Behind these towers to a considerable height the stretch of land now known as Graham's Land. From the observations of Biscoe and others, we learn that beyond the 60th parallel of latitude east winds prevail. The results of this expedition were of high importance; but notwithstanding that some maintain Graham's Land and Alexander Land to have no connection, Dr. Neumayer believes this still remains an open question.

The discoveries of Biscoe to the south of the Indian Ocean were to some extent confirmed by Kemp, who, in the end of 1833, in 60° E. long. and just inside the Polar circle, discovered the land known by his name. The insular condition of this as well as of Enderby's Land might be held as established, if any dependence could be placed upon the statements of Morrell, an American voyager of 1823; in him, however, Dr. Neumayer puts little faith.

The Messrs. Enderby of London, in the year 1838, fitted out two little ships, the *Eliza Scott* and the cutter *Sabrina*, the command of which they gave to Captain Balleny. The scene of Balleny's discoveries was the waters south of New Zealand, a quarter hitherto but little explored. On February 9, 1839, he discovered three islands, the centre one being in 66° 44′ S. lat., and 163° 11′ E. long. He did not manage to make his way farther south than 69° in 172° 11′ E. long. During the month of February, he sailed westwards on the 65th parallel, and on the 3rd March, in 118° 30′ E. long. and 65° 25′ S. lat., he found what is now known as Sabrina Land. More than once previous to this he believed he had seen signs of land, but the dense fogs prevented him from verifying his conjectures. In pursuing these discoveries in lower latitudes, the two little ships suffered much from violent storms, in one of which the *Sabrina* was lost with all hands.

(*To be continued.*)

BELGIAN CONTRIBUTIONS TO ASTRONOMY

Tableau de l'Astronomie dans l'hémisphère austral et dans l'Inde.—De l'Astronomie dans l'Académie Royale de Belgique, Rapport séculaire (1772—1872). Par Éd. Mailly. (Bruxelles, F. Hayez, 1872.)

TWO publications by the same author lie before us, each meriting a separate notice. Of the first—an extract from the *Mémoires de l'Académie Royale de Belgique*,—it is difficult to speak more highly in many respects than it deserves. Learned and full as to its matter, clear and perspicuous in style, it tells in a very pleasant as well as instructive manner the story of southern astronomy. A good deal of misapprehension, we believe, exists as to the beauty of that part of the heavens which is for ever hid from European eyes. The Southern Cross seems to be more remarkable for its associations than its grandeur; and Canopus, the only gem of extraordinary brilliancy which never rises here, is yet outshone by our familiar Dog-star. Some parts indeed of the southern Galaxy are extremely luminous; and this may well be admitted without subscribing to the assertion of a somewhat flighty Hellenic observer, that around the bow of Sagittarius it gives light enough to read the smallest print! and the marvellous variable η Argus, ranging from rivalry with Sirius down to the edge of invisibility without a telescope, is an object of interest for which, in its own way, we might seek a parallel in vain. But on the whole we may well feel that there is nothing in the hidden region to compensate a voyage to gaze upon it. Nor indeed is that region as extensive as, without reflection, might be supposed. The part of the sky which never rises being equal to that which never sets, its radius is the distance of the pole from the N. horizon; and mere inspection will show that this is no preponderating portion of the whole, if to the visible hemisphere we add all that part, which, though beneath the horizon at any one time, will successively come into view at other hours of day and night. All this is of course perfectly obvious to any student of astronomy; but we mention it because the idea is perhaps not often realised, how little, comparatively, of the sky we lose in our latitudes, and that little not of the most interesting character.

If, however, we exchange the naked eye for the telescope, we shall to some extent reverse our opinion. For our visible heavens contain no equivalent to α Centauri, the finest as well as the nearest of connected pairs; or to such superb agglomerations of stars as 47 Toucani with its ruddy heart and white border, or ω Centauri, staring like a comet even to the naked eye; or all the richness of manifold combinations in the Nubecula Major. Such are the regions whose investigation by successive explorers has been so well delineated in the pages before us. We have sketches by a master's hand of many an earnest labourer whose best years were devoted to the undertaking. Among the rest we recognise the youthful Halley, who commenced at the early age of twenty the first regular telescopic survey of these unfamiliar regions, experiencing, in consequence probably of his youth, the vexatious tyranny of some petty despot at St. Helena, whose name, withheld by him, is not worth digging up out of merited obscurity;—Lacaille, the diligent, the accurate, the honourable, who on his return to France, out of 10,000 livres granted for his expenses, notwithstanding his having exceeded his stipulated task, insisted upon restoring the overplus of 855 to the Treasury;—Sir T. Brisbane, who had served under the Iron Duke, in the Peninsula, and whose appointment to the governorship of New South Wales led to a characteristic anecdote: Lord Bathurst having stated at head quarters "qu'il avait besoin d'un homme pour gouverner la terre et non les cieux," and Brisbane having appealed to his old commander as to whether his love of science had ever interfered with his professional duties, the reply was, "Non, certainement, et je dirai que dans aucune circonstance vous ne fûtes absent ni en retard, le matin, à midi, ou pendant la nuit; et qu'en sus, vous fournissiez le temps à l'armée."—Then we have the vicissitudes of honour and contempt encountered by Dunlop, whose unintelligible "Angosiades" (to borrow de Zach's expression) at Paramatta were more injurious to the progress of astronomy than the blunders of the unlucky old chevalier at Tarbes;—the unmerited troubles and vexations and mortal sickness of poor Fallows, condemned to work with a bad instrument, and abandoned without help till he found his best assistant in his devoted wife;—the brilliant career of Henderson, the detector of the parallax of Sirius;—the laborious attempts of Maclear to deduce the solar distance from observations of Mars, whose fault it certainly was not that the result was but partially satisfactory; and his more successful verification and correction of the meridian arc, not quite so accurately measured by Lacaille a century before—all these are given in most interesting recital, together with equally detailed notices of many less generally known observers. We have also a full record of a scientific expedition which has, perhaps, attracted too little attention in England—that sent by the United States to Chili; how Lieut. Gilliss erected his observatory on the columnar rock of Santa Lucia, in the middle of the town of Santiago, 176 feet above the street, where the stones could not be blasted for fear of doing mischief below, and had to be split up by water after being roasted with flame; how the inhabitants came up at night by hundreds to see and gaze through the astonishing *Maquina*, and had their curiosity gratified by the good-natured Americans, even to the sentry's turn last of all; how the weather was almost too fine, drawing so much upon their energies by the unremitting work of a hundred nights, of which seventy-two out of sev six had been continuously clear, that they found the p odical rains setting in none too soon, and Gilliss's vi was so dried up to the native standard of apathy, t he required a month of horse exercise to set him r and how, with a staff so inadequate that they were ob to confine their work to a portion only of the sou sky, 20,000 new stars were registered—a noble ad of which we have reason to hope for the publication a distant time.

Such are a few only of the narratives with w this admirable memoir abounds; and we only reg that our cordial appreciation of its general excelle is subject to some few, though not material, drawba in the way of omission. The graphic way in which m circumstances and incidents are interwoven in the r tion of less important undertakings makes us cons that the story of Sir J. Herschel's memorable exped to the Cape has been told in a too compressed fo and that details are comparatively absent which wo have furnished matter not only of interest but of instr tion. The candour of the writer has led him to s that much of his recital is based on an article in *Edinburgh Review*: it would, perhaps, be an unfair, b it may not be an unnatural, inference that he had not h an opportunity of fully mastering the magnificent reco of the Cape observations which astronomy owes to t liberality of the Duke of Northumberland. We miss, t the first outspoken challenge of the pseudo-planet Vul uttered from a southern latitude, and justified by t event—the retort, not over courteous, of Liais, "L'obse vation du Dr. Lescarbault est fausse." And we shou have preferred fuller information respecting the desi of the great Melbourne reflector, and the conflictin opinions regarding its success. But we should be sor to appear even to detract from the merits of a mem which deserves, and will obtain, so high a rank amo the materials for a general history of modern astronomy.

The second pamphlet is also extracted from the "Livre commemoratif" of the same scientific body, and is a history of astronomy as connected with the Académie Royale of Brussels, which has just reached the end of its first century. Its range is accordingly more limited, but the talent of its author has imparted a more than local value and interest to its contents. The Academy, founded under the auspices of the Empress Maria Theresa in 1772, experienced a total interruption through political troubles from 1794 to 1816. During its earlier existence it failed to awaken a scientific spirit in the Belgian provinces, and depended almost entirely upon the contributions of foreign talent, in which the conspicuous share claimed by England is testified by the names of Needham, Pigott, and Mann. A geodesical survey of Belgium being greatly needed, and the terms of some foreign astronomer being found exorbitant, application was made to Pigott, who was passing through Brussels in 1772 on his way to Spa. He immediately gave up his intended journey, and applied himself to the undertaking with a generous and disinterested earnestness which ought never to fall into oblivion. For five months, accompanied by his son, Mr. Needham, and his servants, he carried on the survey at his own cost, and with his own instruments, sent for from his observatory at Frampton House, near

Cowbridge, Glamorganshire. His enterprise met with all the reward he desired in the rectification of maps, in which some towns had been misplaced to an extent of five, ten, or fifteen leagues, or even more ! At this period there was actually no observatory in Belgium.

The varied labours and scientific insight of the Abbé Mann, a native of Yorkshire, who had turned Roman Catholic, served in the Spanish army, and become Carthusian, require more than a passing notice. Though Halley had previously traced an analogy between the tails of comets, the aurora, and electrical emanations, Mann might be considered in advance of his time in referring these phenomena, with light, heat, and magnetism (as a modification of electricity) to the same general principle, elementary fire ; and his view, expressed in one striking sentence, "Tout est analogue et harmonique dans la nature universelle," would still be considered as the annunciation of an eternal truth. The imperfection of their instruments misled these sagacious reasoners as to the identity of the Galaxy, stellar clusters, and nebulæ properly so called ; but restricting their too general hypothesis to this latter class, the anticipation is sufficiently striking which refers them to assemblages of primordial light or electric fluid, the luminous material of which the sun and stars are formed. And the words with which Mann commences his speculations are an embodiment of wise and sound thought : "On peut bien penser qu'une bonne partie de ce que je vais dire ne sera que des conjectures ; mais quand les conjectures sont fondées sur des observations et des expériences, et qu'elles donnent des explications naturelles des phénomènes, elles ne doivent pas être exclues de la physique, si on ne veut fermer la porte aux découvertes, qui ne viennent pour la plupart qu'à la suite de quelque conjecture heureuse, confirmées peu à peu par de nouvelles preuves, jusqu'à ce qu'elles parviennent au point d'une certitude entière."

The doubts with which the first discovery of the planet Uranus was received are recorded among these early memoirs ; they are well known—more so, probably, than an anecdote which was communicated to the present writer by a friend of the illustrious discoverer. When Sir Joseph Banks, and other fellows of the Royal Society, had failed to find the new object, Herschel had a portable tube constructed of silk, packed it up with his mirrors, and gave the doubters the meeting on the roof of Somerset House, where, the planet having been exhibited, Sir Joseph took off his hat and made him a bow, the rest of the company following his example.

After the reconstruction of the Academy, a considerable time (1816-1834) elapsed before it gave signs of activity ; and the state of science in Belgium may be conjectured from the fact that in 1823 the question was seriously proposed by that learned body whether the law of nutation was accurately understood, and, as well as the planetary perturbations, could be shown to be in accordance with the Newtonian theory. Two years afterwards, indeed, they decreed a prize to the Double Star Observations of Herschel and South. But even this was not done without such a singular deformation of the latter's name as must have much moved his choleric temperament, when he recognised himself (not, perhaps, immediately) as "un Anglais nommé Sawt !" However, during this period a master spirit was introduced among the members. To the energy and perseverance of Quetelet, among obstacles of no uncommon kind, was due the foundation of an Observatory at Brussels, which received its instruments in 1834 ; and with the election of this astronomer at that period to the office of perpetual secretary commenced the era of scientific and intellectual progress in Belgium. We have not space to enter at length upon the subsequent history of the Academy ; but will only indicate a few points of interest with which some of our readers may, perhaps, not be familiar. Such are the following :—

The extension, by Baron Behr, of the very curious relation between the periodic times of the four innermost satellites of Saturn to the other members of the system, the revolution of Hyperion being quintuple that of Titan. The continuance of the alternate recurrence (1, 3 ; 2, 4 ; 5, 7 ; 6, 8), with a break in the order and value of the relation, will be noted, as well as the probability that either the apparent vacancy between Rhea and Titan is a real one, or must contain *two* undiscovered satellites. The periods of the satellites of Jupiter are known to be only approximately commensurable ; but the Baron has found that the revolution of the fourth equals twice that of the third plus $\frac{4}{3}$ of the difference between those of the second and first. Then we have Capocci's idea, in 1850, of a parabolic mirror formed by the rotation of a vessel of mercury, and utilised for a telescope by a large "flat," with Krecke's suggestion that a mass of melted metal might thus be cooled into a permanent paraboloid ; a notice of M. Neyt's (of Ghent) great success in lunar photography with a silvered mirror of $9\frac{1}{4}$ inches ; of delineations of Mars executed in 1864, 1867, and 1871, by Dr. F. Terby (from whom, by the way, we are expecting a valuable monograph of this planet) ; and of a catalogue, now in progress, of 10,000 stars. Besides these, there is much valuable information relative to meteors, zodiacal light, tides, geodesy, and similar subjects ; and the impression of activity and progress conveyed by Dr. Mailly's excellent memoir is full at once of promise and pleasure. We sincerely thank him for his labours, and wish him and the Society of which he is so able an historian all possible success.

T. W. W.

OUR BOOK SHELF

First Principles of Human Physiology, &c. By W. T. Pilter, certificated Teacher of the Science and Art Department. (London : Kempster, 1872.)

AMONG the least questionable services of the South Kensington establishment are the classes which have been held, under the superintendence of Prof. Huxley, and the personal guidance of three of our best physiologists, for instructing school-teachers in the elements of anatomy and physiology. The present hand-book may be taken as one result of these classes, and is interesting as an exhibition of what physiology looks like from what may be called the lay point of view.

The arrangement followed is that of Prof. Huxley in his admirable "Elementary Lessons," of which in fact this little book is a kind of diluted abridgement. Few readers will be sorry to miss the comparison of the three Cæsars, with the quotation from Hamlet, and the famous story of Mrs. A. ; but even in his weakest moments the master quotes Shakespeare, while the pupil introduces embellishments without alleviation.

It is only fair to say that the author writes clearly, and apparently has an intelligent understanding of the facts of physiology himself as far as he goes. Occasionally he gives a useful illustration or a detailed explanation which is not to be found in the Elementary Lessons, and there are not many bad blunders. The account of a cell at p. 14 is obsolete, though too often found in the minds of compilers of manuals and of examiners. Arteries are not lined with mucous membrane. The account of long and short sight is inexact. The *corpora quadrigemina* can be seen without removing the cerebellum, and do not consist of the olfactory and optic lobes. On the other hand the "*hold* of nervous system on the arteries" is a very happy expression, and the plasma of the blood exuding through the capillaries is well compared to "a stream lost in the sand." The experimental illustrations at the end of the chapters are good, and it would have been well if this part of the plan had been more fully carried out, together with some practical hints as to dissection and microscopic observation. Unless these practical studies are undertaken, the study of physiology is a mere cramming of statements, and is quite unworthy of a place in any scheme of education. If it is to be generally taught, the most important thing is to show teachers how they must set about it, and for this purpose directions can scarcely be too minute.

The questions in the appendix are excellent, though it was a pity to give only one specimen of an examination paper. They of course presuppose dissection of a sheep's head and viscera, and acquaintance with some simple physiological experiments. The woodcuts are very rough, but most of them answer their purpose.

On the whole it is not likely that any shorter or simpler manual than Huxley's "Lessons" can be written, that will be of use for the serious study of the elements of physiology by those who do not intend to go further. It would cost much more time and trouble to go through it than through the "popular" substitutes of which this is an example, but, for that very reason among others, the result would be far more valuable. P. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Our National Herbarium

It is with as much pain as surprise that I notice in your impression of last Thursday a most unfair as well as ungenerous attack upon the botanical establishment at Kew under Dr. Hooker. It is not within my province to discuss the inaccuracies upon which the insinuations of bad cultivation are founded, nor yet the extraordinary statement that the herbarium which the constant experience of a long life has proved to me to be an indispensable adjunct for the efficient working of a national botanical garden—that this "collection of dead plants," as your correspondent contemptuously terms it—has interfered with the proper care of the garden. There is, however, one of the facts mentioned which my long and intimate acquaintance with the herbarium of the British Museum and its successive keepers, Mr. Brown and Mr. Bennett, calls upon me to deny.

Foremost amongst the "examples of scientific work at the London Herbarium" is given the "Prodromus Floræ Novæ Hollandiæ." That great work, which at once placed Robert Brown at the head of the botanists of the age, was published in 1810, many years before the so-called "London Herbarium" was in existence.

I would add that the second of the works named as an example of scientific work at the London Herbarium was published in 1818, two years before the death of Sir Joseph Banks, the subsequent transference of whose herbarium formed the nucleus of the "London" or "Metropolitan Herbarium."

Nov. 11 GEORGE BENTHAM

PERMIT me to correct some errors of detail into which Dr. Hooker has fallen in his reply to Prof. Owen, printed in a recent number of NATURE.

1. Prof. Owen has no official relation to the Botanical Department, and, consequently, is not acquainted with the particular arrangements between the Trustees and the officers of that department.

2. This department is open in summer from 9 to 6, and in winter from 9 to 4.

3. The officers are required to be in attendance for six hours daily, but as this does not include an hour for dinner, the official hours are the same as at Kew.

WM. CARRUTHERS,
Keeper of the Botanical Department

British Museum, Nov. 4

The Beginnings of Life

ON reading a review of my recently-published work, "The Beginnings of Life," in the last number of the *Academy*, written by Mr. H. N. Moseley, I could not help feeling considerable surprise at many of the statements which it contained. That such apparent ignorance of the facts should have been shown, and that such an inadequate statement of the case should have been made by a distinguished pupil of Prof. Rolleston, I was not prepared to expect. My first resolution was to pay as little attention to the statements of the reviewer as they seemed to deserve. It has, however, been strongly represented to me by friends whose opinion I value that some of the statements ought not to be allowed to pass without comment or contradiction.

Referring for a moment to the reviewer's opinion that known facts seem to warrant the notion that organic matter can only be formed "by a series of gradations brought about by a succession of complex conditions" (the process referred to in my work at vol. i. p. 94), I may remark that many facts bearing against this being the only possible mode of formation of organic matter are stated in vol. ii. pp. 27-33, and 36. Protoplasm (existing as *Bacteria*) is capable of growing indefinitely in a solution of ammonic tartrate; and, to say the least, we at present know nothing concerning the existence of any long series of intermediate conditions between the ingredients of the saline solution and the protoplasm which rapidly grows therein. As I have said (vol. ii. p. 28), "The most simple not-living or mineral constituents coming into relation with one another in the presence of pre-existing protoplasm, appear, for aught we know to the contrary, to fall at once into those subtle combinations which constitute the basis of living protoplasm. The rapidity of the process mocks and defies all theoretical explanation. Here at all events there seems to be no laborious process of synthesis—no long chain of substitution compounds before the final product is evolved." It has been commonly assumed that the process of "origination" is intrinsically different from the process of "growth," so far as living matter is concerned. One of the principal objects of my investigation, however, was to endeavour to ascertain whether this assumption was warranted by the facts. If experimental evidence seemed to show that an independent elemental origin of living matter was possible, we should have a very fair right to assume that the process of "origination" was not much more gradual or protracted than the process of "growth."

Turning now to the question of the nature of the evidence concerning the origin of living matter, it appears that the reviewer is content to admit what I have so frequently stated, (NATURE, No. 35, p. 171, and No. 47, p. 412; "Modes of Origin of Lowest Organisms," p. 32), viz. that Bacteria develop in solutions, or parts of solutions, in which no particles can be observed with the microscope. It is true that the reviewer even says nothing about my having ascertained such a fact; he assents to it (notwithstanding the objections previously urged by Prof. Huxley), apparently because my friend and colleague, Dr. Burdon Sanderson, has since been compelled to come to a similar conclusion (*Thirteenth Report of the Med. Off. of Privy Council*). *Bacteria* appearing in such a manner in a solution, must either be the developed representatives of invisible germs thrown off from some pre-existing form of life, or they must be developed representatives of invisible germs on nuclei which had been engendered *de novo* (vol. i. p. 297). Experimental evidence alone can enable us to decide whether the latter of these equally legitimate though rival hypotheses is at all tenable. Fortunately, however, the experiments to which we are compelled to resort may be of the simplest description (vol. i. pp. 311, 337, and 350). Suitable fluids require to be boiled for a time in a glass vessel, the neck of which, if not many times bent or plugged with cotton wool, must be hermetically sealed in the flame of the blowpipe before the process of ebullition has entirely ceased.

"It is admitted now on all hands," the reviewer says, "that prolonged exposure to the action of boiling water destroys all life in solutions; hence, if undoubtedly living things be found in solutions treated as above, from which germs have certainly been excluded, the only possible explanation of the phenomena is that the living things have been evolved *de novo*." The reviewer then states that Pasteur, Lister and others had tried such experiments with a number of solutions capable of supporting life, and had found "that no living things whatever developed themselves." Subsequently he states that Dr. Sanderson had also repeated such experiments with similarly negative results. Strangely enough however, the reviewer says nothing concerning certain other experiments made by M. Pasteur, (see vol. i. pp. 340, 374—399), in which, using different and more suitable fluids, living organisms were almost invariably found in his experimental flasks; and as he is similarly silent concerning the multitudes of such experiments, with similar results which have been made by Needham, Spallanzani, and Schwann, by MM. Pouchet, Joly, and Mussett, by Professors Mantegazza, Jeffries Wyman, Cantoni, Hughes Bennett, and many other experimenters, one is forced to conclude either that the reviewer is ignorant of the whole history of the subject and has not even read the book which he affects to criticise, or else that he has acted in a manner which, without explanation, is not quite easy to understand.

Without, however, exhibiting any consciousness of having made material omissions in the statement of his case, the reviewer then proceeds to demolish and explain away the results of my own experiments, as though they alone stood in the breach. The process is summary, if not very original. Taking up the view previously expressed by a distinguished biologist, he admits that "the only possible answer" to the results which I obtained (short of coming to a conclusion similar to my own) is to suppose "that the bodies seen in the solutions were not living, but dead, and had been there all the time." Seeing, however, what an abundance of evidence in disproof of such a supposition has been given in my work (See Series *a*, Exps. 2, 4, and 5; Series *b*, Exps. 2, 4; Exp. *b* (p. 443), Exps. *c*, *j*, *m*, *n*, *s*, *x*, together with very many of the experiments recorded in *Appendix* C), I can only conclude that these portions also have unfortunately escaped the notice of my reviewer, more especially as he ventures to state that "The only attempt made to determine whether the organisms observed in the solutions were living or not, was in the case of Exp. 4, vol. i. p. 368." With regard to the reviewer's further statement that "the turbidity or scum in the solutions was not caused by a development of organisms, but by some coagulation or similar alteration in the fluid," the suggestion is really almost too puerile to be worthy of serious notice. If freshly-filtered infusions of hay or turnip are prepared in the manner above described; if they remain clear for a time after they have been boiled; if, in a few days, they gradually become turbid, and if, on subsequent microscopical examination, it is found that the turbidity is in all cases due almost solely to the presence of myriads of *Bacteria*, *Vibriones*, and perhaps *Leptothrix* filaments (such as are figured in vol. i., Fig. 24), one can only renew a query previously put:—"Can dead organisms multiply in a closed flask to such an extent as to make an originally clear fluid become quite turbid in the course of two or three days?" ("Modes of Origin of Lowest Organisms," p. x.)

It may be well to remark here, also, that the truth of the general doctrine as to the possibility of the independent origin of living matter, is in no way essentially bound up with the results of my experiments with saline solutions. For reasons fully detailed in my work, I am strongly inclined to believe that the bodies figured by me as found in these more or less pure saline solutions had been formed therein. Fortunately, however, even if I were quite wrong in the interpretation of this portion of the evidence, there would still remain a superabundance of it in favour of the truth of the general position which I and many others support concerning the origin of life.

Like others who have written on the same side of the question, the reviewer in the *Academy* shows a strong tendency to accept in an unconditional manner the experimental results and conclusions of some favoured worker. Formerly Pasteur's experiments were much lauded, and the existence of atmospheric germs was believed (as he himself put it) to have been "mathematically demonstrated." Now, however, M. Pasteur is thrown overboard; for, as the reviewer tells us, "Dr. Burdon Sanderson has recently shown that in the case of Bacteria this view can no longer be maintained." It is a source of much satisfaction to me that Dr. Sanderson's very conclusive experiments should have forced him to come to this conclusion, because they were confirmatory of others made independently by myself ("Modes of Origin of Lowest Organisms," pp. 30 and 91), and published somewhat earlier. But if the causes of fermentation and putrefaction are not derived from the air, it becomes obvious that they must be contained in the fluids employed. These causes are, however, by no means necessarily germs of Bacteria, as Dr. Sanderson's language would seem to imply.

It now happens that Dr. Sanderson's experiments are constantly quoted as though they were irreconcilable with my own. This, however, is quite a misconception. In many respects, as I have in part already shown, our conclusions have been similar. Dr. Sanderson has, however, employed only a limited number of different solutions, and these mostly of a kind not adapted for demonstrating the independent origin of living matter. He expressly states that he was interested only in the behaviour of certain fluids, and having found, as others had done, that there was no reason to believe that living matter could arise in them *de novo*, he was quite content: though with reference to an independent origin of living matter he says, "It will be quite unnecessary either to deny or to assert its possibility under other and different conditions." It certainly is somewhat unfortunate that Dr. Sanderson should not have been induced to carry his experiments a little further, and ascertain what would have been the result of similar methods of experimentation with other fluids (*See* vol. ii. p. cl.)—with infusions of hay or turnip, for instance. But unless he also is prepared to reject, as untrustworthy, all the experiments with positive results obtained by Pasteur, Pouchet, Wyman, Cantoni, myself and others, Dr. Sanderson should, from his present standpoint, be a believer in the possibility of the independent origin of living matter.

The reviewer deals with the third part of my work in a very extraordinary and summary manner. He looks upon it as a tissue of "absurd statements concerning heterogenesis," and does not think it worth his while even to mention the fact that more or less similar phenomena have been seen by many excellent observers—by Turpin, Kützing, Reissig, Harte, Gros, Pringsheim, Pineau, Carter, Nicolet, Pouchet, Schaaffhausen, Braxton Hicks, and Trécul—and that the author whom he criticises, merely comes in as one capable of supplying that confirmation which is commonly demanded when we have to do with an order of facts not generally admitted. The actual observations of all these independent investigators are passed over and ignored, apparently because Mr. Moseley is not able to undertand that phenomena which widen the range of our experience are not necessarily "opposed to all the accepted facts and theories of biological science." He does, however, criticise in a very characteristic manner one particular set of observations of my own of a startling nature, in which the development of Free Nematoids, belonging to the genus *Diplogaster*, was seen taking place from a number of the altered spores of a fresh-water alga named *Vaucheria*. After the reviewer has done a little work at the subject himself, he will doubtless become thoroughly convinced that the "crucial observations" to which he refers do unfortunately "lie outside the province of heterogeny" (see vol. ii. p. 37, note 1; and 519, note 1). He seeks to set aside my conclusions by suggesting a series of possibilities which are so little recondite that they might, even by an ordinary use of the imagination, fairly be considered to have been duly weighed by the observer himself. Whilst the reviewer is also not ingenuous enough to confess that I should in all probability be thoroughly familiar with the appearance of Free Nematoids and their eggs, he, without the least hesitation, again suggests an explanation whose only warrant seems to exist in the supposed necessity for upsetting my statements. I can assure Mr. Moseley, however, that after having worked for more than three years at the subject of the distribution and anatomy of Nematoids (Trans. of Linn. Soc. vol. xxv., 1865, p. 73; Philosoph. Trans. 1866, p. 545). I have never seen anything in support of his altogether gratuitous supposition that "considerable variation in size may exist in the ova produced under various conditions by individuals of the same species."

H. CHARLTON BASTIAN

University College, Nov. 9

Physics for Medical Students

YOUR correspondents on this subject in the last number of NATURE entirely agree with me that "a medical man should have some knowledge of natural philosophy and its applications to the conditions with which he has to deal;" but there are one or two points on which they seem to have misunderstood me. As one of the examiners who set the question challenged by Mr. Heath, I defended it, and pointed out that it bore a very close relation to medical science, besides showing, by the simplicity of the solution, that it was one of the mildest questions which could be set.

If my friend Dr. Beale will refer to my former letter, he will see that I nowhere regard the production and waste of heat in the body as one of the mildest of questions.

I ask whether a medical student should not know something of such important matters, and wish to imply that, in order to know, he must acquire some knowledge of the simplest principles of heat. He is not likely to acquire these unless they form a part of the preliminary training of medical students. I presume Dr. Beale will admit that just so far as man can be regarded as a molecular body, capable of absorbing or radiating heat, to the same extent must the laws of molecules apply to him; for his position is untenable that medical men need a knowledge of Physics, if the laws of Physics do not apply. His remarks on materialism are not warranted by anything in my letter, and do not apply to me. I will not attempt to answer in these pages the general questions proposed by Dr. Beale, on the heat-giving properties of food, or on the waste of heat from the body, nor to describe the methods by which researches on them have been or may be carried out. It is well known, and a medical man who wishes to be stamped with a medical degree ought to know, how much heat a given quantity of food is capable of producing, and also that this amount of heat is exactly equivalent to a certain definite amount of energy: the form in which this energy will show itself in the human body in all the different stages of growth and decay, both in health and disease, is essentially a question for medical men to study.

Physical Laboratory, King's College W. G. ADAMS

Diathermacy of Flame

WILL you be so good as to allow me to draw the attention of your correspondent, Mr. W. Mattieu Williams, to what appears to be an oversight in his letter on "The Diathermacy of Flame," published in your number of Oct. 17 last. Near the bottom of col. 1, page 506, he says, "My flames were thus maintained at a *constant mean distance* from the thermometer;" and, farther on, "Here, then, is a serious discrepancy. I get an increase of 4° by the first addition of two flames, and by eight such additional pairs obtain an increase of 34° instead of the 32° due to theoretical diathermacy," &c. The explanation of the discrepancy seems to be that the radiant heat from a flame, like that from any other body, varies as the inverse square of the distance, and therefore the total effect is proportional to $\frac{1}{d^2} + \frac{1}{d'^2} + \frac{1}{d''^2} +$ &c., not $\frac{1}{d} + \frac{1}{d'} + \frac{1}{d''} +$ &c., where d, d'', &c., are the distances of the flames from the thermometer; in which latter case the order of lighting the jets would answer the desired object.

Without going further into the subject, I would also draw attention to the desirability of keeping the gas at constant pressure, in order that the flames may be always of the same size and shape. It does not appear to be sufficient merely to record the quantity of gas consumed.

The Castle, Parsonstown, Nov. 5 ROSSE

The Corona Line

IT is rather absurd, as Capt. Herschel says, for an American to carry on a discussion with a resident of India through a London periodical; but there are one or two points in his letter of July 29th which I should like to notice.

In the first place, let me acknowledge my mistake as to the original proposer of a chart of the spectrum based upon a scale of inverse wave-lengths; the error arose in the manner Capt. H. supposes. Let me add also my profound satisfaction—shared, I am sure, by all who work with the microscope—on learning, a few months ago, that such a chart is in preparation, and that under the charge of a committee of the British Association.

Next, as to the question, "What guarantee was there that No. 31 of the Preliminary Catalogue was the 'coronal line,' anterior to the Dodabetta measurements?"

In 1869 the case stood thus, so far at least as my own observations are concerned:—In July I had found (not *discovered*, for Mr. Lockyer had anticipated me, although I did not know it until October) that the 1474 dark line was generally reversed in the spectrum of the chromosphere. I had been led to examine this part of the spectrum with especial care by the report of green lines seen by Pogson and Rayet during the eclipse of 1868.

On the forenoon of the day of the eclipse of 1869 (August 7) this line was distinctly reversed at several points on the sun's limb, and with my instrument no other bright line could be seen near it. When, therefore, in the afternoon during the eclipse, I saw in that part of the spectrum a strong, solitary bright line, I considered myself warranted in identifying it with my old acquaintance, 1474, particularly as the measurements of Prof. Harkness, with a one-prism instrument, accorded as well as could be expected.

In 1870 the matter was examined more critically. A few minutes before totality, the 1474 line being already distinctly, and even conspicuously, reversed, the cross wires of the spectroscope micrometer were carefully adjusted upon it, and as soon as totality began the corona all around the sun was thoroughly explored without disturbing the micrometer setting. The bright line remained entirely unchanged in position under the whole dispersive power of thirteen prisms, very bright near the moon's limb, but fading to imperceptibility at a distance of from 10′ to 20′.

It seems to me, therefore, that the Dodabetta measurements must be regarded as merely confirming what was before fully ascertained. Of course it was highly desirable that the fact should not be allowed to rest upon the testimony of any one observer.

Then as to another point—the puzzling coincidence between the coronal line and a line in the spectrum of iron.

The absence of hundreds of other and more important iron lines from the coronal spectrum, and the difficulty of supposing the vapour density of this metal less than that of hydrogen, or of otherwise accounting for its presence in such quantities in the upper portions of the solar atmosphere, made it from the first highly improbable that this line could be due to iron. Now I think I can add another fact pointing in the same direction. During the past summer, observing at an altitude of more than 8,000 ft., I have repeatedly witnessed solar disturbances by which the b's, the E lines, and the double iron line 1463 K (all in the same field with 1474) were considerably displaced and distorted, while 1474, and some other lines of unknown origin near it, were not in the least affected. I think therefore I may say that 1474 does not usually sympathise with the lines of the iron spectrum, and this adds to the probability that it is of different origin.

But, on the other hand, so close is the coincidence, that the more I examine the matter, the harder it is to suppose that we have to do with a mere accidental juxtaposition. For one I am very anxious to hear whether the new and unequalled instruments of Dr. Huggins throw any further light upon the subject, and I should be very glad to hear that they show the non-coincidence of the bright and dark 1474's, because it would greatly simplify the problems, but I cannot say that I expect such news.

Now if the coincidence is absolute, there must be some reason for it; either the coronal matter exists in terrestrial iron as an impurity, or the two substances have in their molecular constitution some similar dimension, some common parameter, which accounts for this identical vibration-period; for I take it even an *absolute* coincidence between the lines of two spectra entirely independent in their origin is infinitely impossible—I mean of course coincidence determined to be such by a spectroscope of infinite dispersive power.

As to the numerous coincidences observable upon the charts of Kirchhoff and Angström, between the lines of iron, titanium, and calcium, it seems most likely that they originate in the slight impurity of the metals used by the experimenters. Certainly the matter merits most careful investigation, for if this is not the case a road would seem to be opened by which we may hope ultimately to penetrate many of the secrets of metallic molecules.

C. A. YOUNG

Dartmouth College, U.S.A. Oct. 10

Brilliant Meteors

ON Sunday evening, (Nov. 3), at 5.30, a magnificent "bolide" was observed at Glasgow, shooting athwart the sky. It made its first appearance in the Constellation Auriga (about

0° to the left of Capella); from thence it glided slowly across e sky, shining with a brilliant *green* light, and exhibiting a pear-haped disc of *one-third* of the apparent diameter of the full oon. When it had arrived at the middle of its path (being lmost due north), its velocity abated, and its colour changed to *whitish-blue*. The meteor, accompanied by a diminutive *red* ail, and followed by a train of sparks, then regained its original elocity, and gradually approaching the horizon, eventually isappeared behind a cloud lying parallel, and close to the orizon in the N.N.W. The whole time occupied during its ight being 2·5″. In my letter reporting the auroral display of Nov. 10 last year, I suggested the application of Photography to he solution of auroral problems; might I venture to ask if any f your photographic correspondents have been able, during the isplays of this year, to prove the possibility of taking auroral hotos? I think the results would be interesting to most of your eaders. ROBERT MCCLURE

Glasgow, Nov. 4

On Wednesday night the 6th November, whilst looking from this place over the sea, directly west, a few minutes before ten o'clock, I saw a meteor of large size subtending I should think one-sixth the angular magnitude of the moon. It was accompanied by a short scintillating train, and moved slowly quite parallel with the horizon directly north. Its elevation was about 15°, and its rate of motion I should think 1½° per second. The night was dark and somewhat cloudy, and the line described by the meteor seemingly quite straight. D. WINSTANLEY

Blackpool, Nov. 8

Day Aurora

WITH respect to the "Day Aurora" alleged to have been seen by Secchi (see vol. vi. p. 492) his description is not that of an aurora, especially as regards its position, which was far from being at right angles to the magnetic meridian; and as regards the "fantastic rays (*jets filamenteux*)" whose "forms perfectly resembled those of the solar protuberances," they would therefore be very unlike the rays of an aurora. T. W. BACKHOUSE

Sunderland, Oct. 30

THE KATIPO OR VENOMOUS SPIDER OF NEW ZEALAND

FROM the interesting "Field Notes of a Naturalist in New Zealand," which have been appearing in the *Field* for some weeks, we extract the following description of this hitherto little-known animal.

Among the invertebrata there is a venomous spider known as the "katipo;" and, as this is almost the only noxious inhabitant of the land, it may be interesting to give some account of it, especially as there are some very curious points in its natural history. The first scientific notice of the existence of a poisonous spider in New Zealand was furnished by Dr. Ralph, in a communication to the Linnean Society in 1856 (see Journal Proc. Lin. Soc., vol. i., 1856, pp. 1, 2). Dr. Ralph's paper contained a short description of the full-grown spider, observations on its nesting habits, and an account of experiments which he had made in order to test the potency of its venom. The native name, katipo, signifies "night stinger" (being derived from two words, *kakati*, to sting, and *po*, the night), and, although more strictly applicable to the venomous spider, it is often used to denote a wasp or other stinging insect. The species has been described and figured in the Transactions of the New Zealand Institute (1870, vol. iii. pp. 56-59), under the name of *Latrodectus katipo*, and is closely allied to, if not identical with, one inhabiting Australia. The exact range of this spider in New Zealand has not been accurately ascertained; but it appears to be rather local in its distribution, while its habitat is strictly confined to the sand hills skirting the sea-shore. Along the coast from Wainui to Waikanae (on the north side of Cook's Strait) it is excessively abundant. From Waikanae to Horowhenua it is comparatively scarce; but at the latter place, and for a few miles farther north, it is said to be abundant. At Manawatu, and thence along the coast for twenty or thirty miles, it is very rare. At the mouth of the Wanganui river, again, it is very abundant; and a story is still current among the natives of the district about a fishing party, all of whom were bitten by this dreaded spider, and in two cases with fatal results.

The writer then adduces several instances to prove that the bite of the spider is occasionally fatal, and certainly very painful and distressing. But, he says, "I have satisfied myself that, in common with many other venomous creatures, it only exerts its dreaded power as a means of defence, or when greatly irritated; for I have observed that on being touched with the finger it instantly folds its legs, rolls over on its back, and simulates death, remaining perfectly motionless till further molested, when it attempts to escape, only using its fangs as the *dernier ressort!*"

The cocoon or nest of the katipo is perfectly spherical in shape, opaque, yellowish white, and composed of a silky web of very fine texture. The eggs are of the size of mustard seed, perfectly round, and of a transparent purplish red. They are agglutinated together in the form of a ball, and are placed in the centre of the cocoon, the exterior surface of which is sometimes encrusted with sand. The spider itself undergoes the following changes in its progress towards maturity:—In the very young state it has its body white, with two linear series of connected black spots, and an intermediate line of pale red; under parts brown; legs light brown, with black joints. In the next stage, the fore part of the body is yellow, with two black "eye spots;" sides black, with transverse marks of yellowish white; dorsal stripe bright red, commencing higher up than in the adult, and with the edges serrated. At a more advanced age the stripe on the back is brighter, with a narrow border of yellow, and the thorax and legs are nearly black. In the fully adult condition, the female of this spider is very handsome both in form and colour. Examples differ considerably in size, the body, which is almost spherical, varying in development from the size of a pigeon-shot to that of a small green pea; and in the largest specimens the outspread legs, measuring across, cover a space of only three-quarters of an inch; thorax and body shining, satiny black; a stripe of bright orange-red passes down the centre of the body, the edges being tinged with yellow. At the anterior extremity this stripe is broad and angular, and is surmounted by an open narrow mark of white in the form of a nail head; below this, and immediately above the junction of the thorax, there are two divergent spots of orpiment yellow, with white edges; legs black, with the extremities inclining to brown. The male is considerably smaller, and has the body shining blackish-brown, with an obscure narrow line of yellow down the centre of the back, broader towards the posterior extremity, and a similar interrupted line on each side of the body.

The spider here described belongs to a genus which contains several species in other parts of the world, also reputed venomous. Walckenaër, writing of the *Latrodectus malmignatus*, an allied species, common in Sardinia, Corsica, and parts of Italy, remarks:—"This spider is certainly poisonous; its bite causes, they say, in man pain, lethargy, and sometimes fever;" and Mr. Abbot, in his account of *Latrodectus* in his "Georgian Spiders," states that its bite is "undoubtedly venomous." It is curious, also, as already noticed by Dr. Powell, that the species of this genus, so widely distributed over the world as to be found in Europe, America, Australia, and New Zealand, should all agree in being black with red markings, for colour is of all characteristics the most variable, and especially so in the case of spiders.

INSECT METAMORPHOSIS*

EVERYBODY, whether learned or unlearned, is aware that insects undergo changes in their shapes and habits. Great numbers of popular works on natural history have made the description of these changes or metamorphoses familiar to the public; and Newport, Dugés, Heroldt, Fabre, and those British entomologists and naturalists whose names are household words amongst us, have informed the scientific world upon the anatomical and minute changes of structure which accompany the wonderful varieties in form and in method of life. The array of facts is enormous, and yet, with all this vast amount of sterling knowledge to build upon, very little progress has been made towards recognising the cause and meaning of metamorphosis in biology—in the science of life. The facts and details of the subject have been accumulating, but the nature of its philosophy has been studied by very few naturalists, and it is only of late years that Lubbock and Fritz Müller, and a few others, have been stimulated by the light of the theory of evolution to examine into it. Believing that the subject is increasing in interest, and that its consideration bears upon some of the most important theories respecting life, it is proposed to devote this lecture to a description of the different kinds of metamorphoses in insects, and to a consideration of the biological meaning of the phenomena.

Let me recall to your recollection two instances of what may be called perfect and complete metamorphoses. When the tenderest cabbages are growing in the early summer, a number of very small caterpillars or larvæ may be seen upon the plants, devouring them in a regular and systematic manner. Avoiding the leaf-veins as indigestible, they nibble the juicy leaf, and consume daily more than their own weight. These pests of the gardener have small heads and ends, and the body is greenish and striped with yellow bands, being at the same time hairy. At first very small in size, the caterpillars do not attract much attention, and especially, as after living for a few days, they hide up out of the light, and look shrivelled and ill. After a short time, the caterpillar in retreat bends its back violently, and splits the skin of one of the rings or segments of the part nearest the head, then a vigorous struggle enables the legs and the head to be withdrawn through the crack, and the larva is noticed to have attained a new skin within the old one. It crawls on to its favourite plant and makes up for lost time, grows rapidly, and really may be said to live to eat. It cares not for its fellows, nor for any other leaves; it is content with its own cabbage, and has no ambition and no desire to quarrel or to move away. During growth the powers of mastication and of digestion increase, but they are checked several times by the larva having to pass a period of quietude whilst a new skin is finished under the old, and whilst this is cast off. These skin sheddings have a definite relation to the increasing size of the insect, but they are not simple changes of skin because the old one has become too tight for its rapidly growing possessor. They accompany certain important changes within the insect, and not only is the outside skin shed, but the mucous membrane of the digestive organs and of the air tubes which enable the creature to breathe, suf also. They are really important elements in the metamorphosi which term includes the sum of the changes of shape, habit, a instinct.

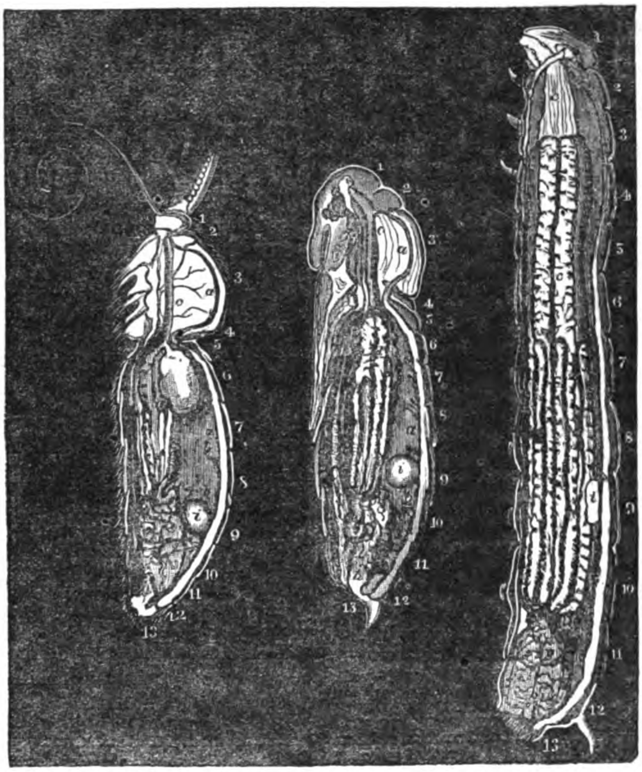

FIG. 1.—Metamorphosis of Tortoise-shell Butterfly.

When full growth has been attained, the caterpillar cra from its cabbage and wanders restlessly about, even to co siderable distances, in search of a dry sheltered spot. Af having discovered such a locality, it fills up the space betw its hind legs with silk, and attaches this part of the body to t wood or stone, as the case may be. The larva then hangs h downwards, and forthwith begins to bend its head backwar upwards, and then from side to side, until, after a little practi it is enabled to touch the solid substance to which it is hang on either side of its body. Then some silk is secreted, and applying the mouth to the spots touched one after the other fine sling of silk thread binds the insect down and prevent from being swayed to and fro by the wind. This is the last of the larva which shows any evidence of will. Then it be to look shrivelled, shorter than before, and broader behind head, and after a time the skin splits, and is shed with greater or less wriggling. A sticky, varnish-looking moisture covers the very different-looking thing which now presents itself, and dries apidly, and forms a case over the skin of the "pupa" beneath. The alterations within and without the insect at this time, that is o say, during three or four days after leaving the cabbage, are carried out with great rapidity, and the future butterfly is well foreshadowed at this period in the structure of the chrysalis or pupa. Hanging as a chrysalis or pupa in a perfectly immobile condition, neither seeing, hearing, nor tasting, and losing very little weight from the exhalation of its moisture, the insect lives on for many months, and until spring has nearly ended. Then the dark case splits, and a tender white butterfly crawls forth, and, under the influence of warmth and the sun, becomes dry, stretches, and unfolds its crumpled-up wings, walks feebly upon long legs, trails a short body, moves a curious flexible trunk in front of its head, the result of the modification of its former jaws, and takes to flight. The common white butterfly, whose solitary flight is so zigzag and wandering, and whose flight in company is so tumultuous, ascending and vibrating, lives for love. It has a soul above cabbages, and rarely condescends even to sip or suck the daintiest nectar from flowers. After a longer or shorter existence, it begins to lay eggs, and places them in the immediate neighbourhood of the favourite food of the larvæ, which are to come from them.

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* A Lecture delivered before the British Association, 1872, by Prof. Duncan, F.R.S.

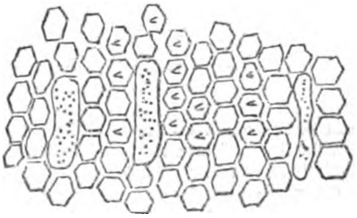

FIG. 2.—Œsophageal Epithelium.

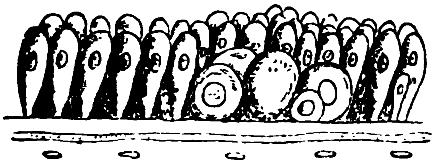

FIG. 3.—Stomach Structure.

Another familiar example of perfect metamorphosis may be studied in the instance of one of the false wasps, *Odynerus parietum*. This small wasp-like insect may be seen on the other side of the Channel in great companies on lucern and clover when in full flower. It is a solitary kind, and the male and female care nothing for their companions, who rush and tumble over, in, and about the flowers, sucking their sweetness, and squabbling and flying for the freshest corollas. Day after day this buzzing busy crowd may be seen leading a life of happy enjoyment, feeding, playing, and flirting; but after a while an unusual excitement is noticed amongst a large number of the insects. These extend their flight beyond the favourite field, and seek the neighbourhood of sandy clayey banks close by. They may be observed digging their heads into the sand with great assiduity, and pulling out sand grains, and gradually forming a hole. Each wasp works independently of its neighbour. As soon as the hole is large enough to admit the wasp's body, the legs remove, by a process of brushing, the particles loosened by the jaws. After a short time the wasp will be found to have made a tunnel, and the constant out-pour of sand and clay indicates that excavation is still proceeding out of sight.

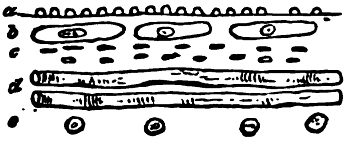

FIG. 4.—Pylorus.

Soon the *Odynerus* perfects two or three chambers deep in the bank and opening into the tunnel. She (for it is the female who does the work) carefully pounds the insides of the cavities and removes all roughness from them, and leaves them as commodious hollows, water-tight, and not likely to fall in. This is not all. On coming back into the light, the wasp seizes cylindrical pieces of earth, and moulds them more or less into shape with her jaws, and places them in front of each other, and side by side, so as to form a hollow tube, which sticks out from the bank and opens into the tunnel. The free end of this ante-chamber is left open, and the pieces of which the whole is formed are gummed together and pressed. The tube is extremely fragile, and the pieces of it are not in contact everywhere. Nevertheless, the *Odynerus* passes along it readily enough, but no other insect of its size can do so. All this work is carried on whilst the wasp appears to be in an intense state of excitement, and when it is completed the insect flies off to the flowers again. But not to return to its former habits. On the contrary, the purposeless tumbling about of flowers, and the occasional sip of nectar, are forgotten, and the flighty little vegetarian becomes a ferocious and ardent huntress of prey. She seeks the small larvæ of a species of weevil which abounds about the plants, and seizing one, digs her sting into it, so that a weak venom is introduced close to the nervous system of the victim. The larva is paralysed at once, but not killed; on the contrary, it remains motionless, but lives. She then flies off with her prey to the bank, enters the tubular ante-chamber, traverses the tunnel, and reaches one of the chambers. Here she deposits her insensible victim, and lays one egg close to it. Returning again to the field, she seizes another larva, stings it, and carries it off to deposit it close to the first. This procedure is repeated as many as thirty times, and the chamber becomes full of insensible weevil larvæ and one *Odynerus* egg. The other chambers are filled in the same manner, and an egg is laid in each. Then the wasp comes out of the tunnel for the last time, breaks down the tubular ante-chamber, so as to hide the entrance to the tunnel and chambers, flies off, and dies. She never sees her offspring, for which she, a vegetarian, has provided animal food in abundance.

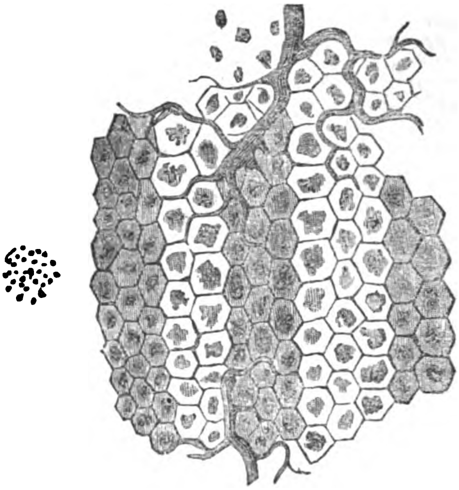

FIG. 5.—Stomach Structure of Pupa.

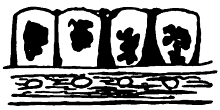

FIG. 6.—Stomach Structure of Imago.

The egg is soon hatched in each chamber, and a small, legless, and extremely delicate larva crawls forth, and seizes upon the victim close to it. So tender is the larva that the least roughness of the sides of the chamber would destroy it, and the least struggle on the part of the poisoned weevil grubs would kill it; but all this has been made safe, and the little thing eats into its living prey, and when one is finished it attacks another, until all are eaten up. This is the life of the larva. It is incapable of walking any distance, and simply leads a life of gormandising on the flesh and juices of weevil grubs. It never emerges from the chamber, and when it has no more to eat, spins a cocoon of silk around itself, and sleeps therein during the late autumn, the winter, and until the spring. Then a change in form ensues, and a pupa, which greatly resembles the perfect insect, appears under the skin which is shed. In the course of a few weeks the perfect false wasp escapes from the pupa skin, digs its way into the world, and emerges to enjoy the destiny already described.

Many other false wasps which belong to the same group of insects as this *Odynerus* have a somewhat corresponding life cycle, and choose many curious kinds of prey, but the formation of the safeguard of the tubular ante-chamber places this kind in advance of all others. It is then an example of very perfect metamorphosis with high instinct, and, like in all other instances of what is termed perfect metamorphosis, there is an intermediate stage of a quiescent pupa between that of the larva and imago, both of which are able to lead independent and distinct kinds of lives, and to take food.

Considered as isolated examples, these two instances of metamorphosis are perfectly inexplicable, except on the theory that the successive changes—shape, structure, and habit—were especially given to the species at their origin, by special creation. When, however, the nature of the very different metamorphoses of other insects, which closely resemble these in structure, is examined into, this view does not give entire satisfaction, and an uncomfortable feeling arises, that we with finite understandings are tying down the operations and mysterious ways of Omnipotence to our own limited standard.

But before proceeding any further, it is necessary that the nature of some of the structural alterations which occur during metamorphosis should be stated. By so doing a distinction can be appreciated between ordinary continuous growth or progressive development, and the changes which occur during the perfect metamorphosis of an insect. Consider shortly the nature of the change of outside form. A young larva of a butterfly or moth has a head which is not separated by a neck from the long body, and the whole is divided more or less distinctly into rings or segments. The three segments next to the head form the chest and support the true legs, and are succeeded by nine others belonging to the body or abdomen. There are then thirteen in all. The body segments are nearly equal, but the last is the smallest, and it, together with some of the other rings, supports what are termed false legs or claspers. They are continuations of the skin, and do not exist in all larvæ of butterflies and moths; and, although they are extremely useful in enabling the insect to hold on and to crawl, they disappear in the pupa state with the last skin-shedding. Thus there is the head segment, and three chest segments, and nine body segments, and on the side of each of these, excepting the head, is a point, which usually marks an opening where air tubes or tracheæ enter the body to ramify over the whole of the internal structures. When within the egg, and before it was perfectly formed, the head of the larva consisted of at least four separate pieces, but these united and coalesced in one before birth. None were destroyed, but the edges of the separate portions fused together. A corresponding fusion and blending of certain of the chest and body segments occurs during metamorphosis, and there is neither a destruction nor new creation of parts to produce the extraordinary difference between the long body of a caterpillar, the short swathed figure of the pupa, and the great chest and small abdomen of the butterfly. The same anatomical elements are present, but they are more or less modified.

The first skin sheddings of the caterpillar do not add to or alter its segments, but the last skin shedding which occurs during a period of immense internal change exposes the pupa or chrysalis to view, and all the characteristics of the skin of the larva are lost. On commencing this last skin shedding, the chest segments, 2, 3, and 4 (Fig. 1) of the caterpillar, increase in size, and the insect really soon begins to shorten. The small Tortoise-shell butterfly larva is thus suspended, with its skin on, for some ten or twenty hours before the chrysalis is revealed. During this time, the 2, 3, 4, and 5 segments become much enlarged and curved downwards by the action of the muscles of their under surface, which are repeatedly contracted and expanded slowly. The skin bursts, and the insect then exerts itself to the utmost to extend the fissure along the segments of the body, and gradually draws out its antennæ, or feelers, and its weak but long legs, and immature wings, all of which have been maturing beneath the old skin, and are covered with an extremely delicate tissue. The false legs drop off with the old skin, and the pupa hangs in this moist and curious condition for a few minutes. Then it makes a few powerful efforts, and contracts and expands itself to the utmost by taking in air through its air tubes and forcing it out again by bringing the segments closer together. The result is to contract the body segments along their under surface, and to diminish their length generally. The front margin of one segment is drawn up within the hinder edge of the one in front, and especially in the case of the fifth and sixth segments. This contraction persists, and in the neighbourhood of the fifth is sufficient to initiate the small waist-like circular division between the chest and the body, which becomes more distinct in the imago than in the pupa. Atrophy and shortening of the fifth and sixth segments occur; and there are corresponding changes in the first and second segments, so as to commence a neck. A gelatinous viscid fluid is secreted by the pupa, and it covers all its delicate external skin, and by hardening agglutinates all beneath. After a while the true skin of the pupa, is found separated by air from the dark pupa case outside.

After the escape of the imago from the pupa case, if its wings be removed, and its head, chest, and body be examined, the distinction between the number of its segments and those of the full-grown larva will be readily appreciated. The nine body-rings of the caterpillar exist, but are much modified. The two terminal are drawn up inside the body, and the first segment has joined itself to the last chest-piece. The shortening is very great, whilst the enlargement of the rings which support the wings—namely, the third and fourth—with much consolidation and fusion of them, does not compensate for it. As may be supposed, the shortening of the internal organs must be extraordinary, and as a matter of fact the nervous cord is shortened, its ganglia are concentrated, and the digestive apparatus is diminished in length in a remarkable manner.

The changes in the digestive organs keep pace with those of the skin and general shape, and may be briefly described as follows:—When a caterpillar nips off a piece of a leaf with its jaws, the morsel is passed into the gullet, which is a short tube leading to the stomach. The gullet is composed of a mucous coat which is internal, and of a muscular covering which is external. The mucous coat consists of a delicate structureless membrane, which is continuous with a corresponding tissue in the mouth in front and in the stomach behind. It is called the basement membrane, and that of the gullet is folded longways when it is empty. When the gullet is crammed with food, the folds are obliterated and the membrane is stretched. All the inside of this membrane is covered with a layer of delicate hexagonal cells, which are very small and thin, and consist of a plain cell wall and transparent fluid contents (Fig. 2). They cover the basement tissue like a pavement, and the morsel of food comes in contact with them, and they absorb and transmit any vegetable liquids which may escape from the cells of the leaf. Between the hexagonal pavement cells here and there are oval depressions filled with granular mucus. The basement tissue is slightly depressed in these spots, and these crypts secrete a fluid which acts like the salivary glands of man upon starchy and sugary fluids. Amongst the hexagonal cells are others which have their upper surface produced into a short tooth-like projection, that foreshadows a remarkable structure in the perfect insect. Outside the basement membrane is a single row of hoop-shaped muscular fibres. They are broad and nucleated, but not striated. Each fibre encircles the gullet, and tends, with the simultaneous contraction of its fellows, to diminish the calibre of the tube, and to throw it into longitudinal folds. Their passive dilatation, on the contrary, permits the gullet to become distended. They have, however, the peculiarity so common in the circular muscular fibres of all animals, of contracting one after the other in series and of dilating or expanding in the same rhythmical manner. The result of this progressive contraction is to force the contents of the gullet in the direction of the stomach. The alternations of contraction and the expansion permit the layer of muscular fibres, which is outside the circular set, and whose direction is longitudinal, to pull up and shorten the canal. The long fibres are tached to a ring behind the mouth, and around the commencement of the gullet, and they are continued down the tube to the omach. They are closely packed, and are very distinct. When e gullet is shortened by their contraction, any food in it is rought nearer the opening into the stomach, and then it is forced to that organ by the progressive contractions of the circular bres. The piece of leaf is lubricated by the granular mucus of e crypts, and is squeezed by the contraction of the circular bres. Much of the contents of the cells of the leaf is thus set ee, and is absorbed by the mucous cells, and transmitted rough the basement tissue to the blood, which permeates all the ssues more or less.

The stomach is large in comparison with the size of the arva, is cylindrical in shape, and does not taper gradually nto the gullet in front and the intestine behind. The alibre is many times greater than that of the rest of the digestive anal. Like the gullet, a mucous layer, a basement membrane, nd two sets of muscular fibres, enter into its composition. But he mucous membrane differs in every particular, except in the tructureless basement membrane. The basement membrane is ensely covered internally by an aggregation of large cells of two kinds, and the more active the larva may be in its eating, the more numerous and larger are these cells. One kind is elongate, nd narrow at the base, where there is an attachment to the membrane, and rounded at the free end (Fig 3). They are thus more or less club-shaped, and they are formed by a very delicate cell wall, a nucleus and more or less granular, coloured, and liquid cell contents. They are crowded together, and belong to what is called columnar epithelium. They become less bulky, thinner, and crooked, if the caterpillar is starved, and just before the skin-sheddings also. Another kind is represented by large globular cells, which are fewer in number compared to the others. They are composed of a very delicate cell wall, of nuclei, and liquid contents, and they burst in the ordinary process of digestion, and appear to supply a gastric juice. The columnar cells, on the contrary, absorb nutritious matters, and transmit them through the basement tissue. These huge cells are very remarkable, and all degenerate, and greater part are cast off during skin-sheddings. A layer of circular or hoop-shaped muscular fibres is found outside the basement membrane, and whilst those of the fore part of the stomach are so closely applied to each other, side by side, as to form a continuous circular muscular coat, those of the nether parts of the organ are wider apart, but at the termination of the canal in the intestine they are again concentrated, and not simply in one row, but in many, so as to form a dense circular muscle or sphincter. The longitudinal fibres are outside these, and are continuous in front with those of the gullet, and they end in the tissue, which connects the dense circular fibres of the sphincter together. The large cells of the inner coat of the stomach are not found on the basement membrane which covers the thick sphincter, and they cease suddenly a short distance in front of it.

This part of the stomach is evidently in very constant and somewhat violent movement, for the use of the dense mass of circular fibres is to compress and crush the food in its passage to the intestine; consequently, a cellular layer exists on the basement, which is suited to bear pressure. The cells of this part resemble to a great extent those of the gullet; they are flat, hexagonal, and pavement-like, but a great number of them have very decided tooth-like projections on their free surface (*a*, Fig. 4). These projections occur in numerous circular series, and they are sufficiently prominent to wound a delicate vegetable cell passing over them, and submitting to the pressure induced by the contraction of the circular fibres. It is evident that if the muscular contraction be great, and the cells of the leaf rather hard, these hexagonal tooth-bearers will suffer from much and perhaps destructive compression.

But a very interesting structure is superadded to this part of the digestive system in order to prevent such an accident to the delicate mucous membrane. There is a layer of very large flattish cells beneath the basement membrane and between it and the circular fibres. Each of these cells (*b*) contains much fluid within a very visible cell-bag, and there are the usual nuclei. They are not quite in opposition laterally, and they rest upon an expansion of the muscular fibres, some granular fluid and nuclei intervening (*c*). Their office is to act as cushions beneath the immediate seat of pressure, and where the circular fibres are the strongest, there they are best developed. This arrangement of fibres, cushion cells, basement membrane, and delicate tooth-like projections, is continued to the extreme end of the stomach. There the circular sphincter muscle exists, and the basement is folded more or less ongitudinally, so as to admit of the calibre of the canal being extended and contracted to the utmost. The cell teeth are found here in angular series, and there is one circular row of large ones. Microscopic examination of the dense mass of circular fibres reveals that the fibres are separate, stout, and that some of them possess a structureless investing membrane (*d*). The longitudinal muscles of the stomach, which are extremely long and close together, end by forming one or even three processes, which are united to the circular fibres, and the corresponding fibres of the intestines take their origin in this sphincter. Many nerves and air-tubes supply this part, which ends in an intestine of moderate length, and which time will not permit me to consider.

These structures are all developed in exact relation with the gormandising habits and the nature of the food of the cabbage-eating larvæ. The pieces of raw vegetable consist of cells with tolerably stout walls, and these have to be broken into before any nutritious matter can be let out to be digested, and the growth of the insect is so rapid that the quantity of food swallowed and passed along the stomach is very great.

This active stomach has periods of rest during the skin-shedding, when the cells of its mucous coat are cast off and replaced by new ones. The day comes at last when the caterpillar loses its love for cabbage and is to get no more, and then, ere it hangs pendent before the alterations in the size of the segments commence, changes may be noticed to have begun in the anatomy just described, changes which might take place from disuse. The stomach is, comparatively speaking, empty of food, the club-shaped cells are smaller and less round, and the globular cells are broken up. The muscular fibres appear thinner, wider apart, and more transparent. Immediately after the agglutination of the outside of the pupa occurs, sensible changes proceed in the digestive canal, and very rapidly. By the fifth day the whole canal has become shorter, the gullet has become thread-like and longer than in the caterpillar. The stomach is not half the length or one-third of the breadth of its former condition, and the intestine is longer than before. A general atrophy of all the layers of muscular fibre exists, and the dense muscular sphincter of the stomach with its peculiar fibres has been absorbed and replaced by simple, separate, and delicate circular muscles. The longitudinal fibres are wide apart, and very transparent. The longitudinal folds of the gullet have disappeared with the mucous crypts, and the basement membrane is covered with a granular fluid, in which the remains of the old hexagonal cells float. A mass of broken-down, club-shaped globular cells occupies the small stomach, and a totally different arrangement covers the basement. Cells packed closely together here and there, and separated by lines of granules, indicate that a new kind of mucous coat is being developed. These cells assume the hexagonal shape, are moderately tall, and contain a few granules, and they extend over the place of the toothed cells at the sphincter, and join the cells of the intestine (Fig 5). The toothed cells have disappeared, and the cushion cells of the region of the sphincter also. All these structures are remarkably delicate and difficult to manipulate, and it may be remembered that they are not performing any function whatever.

When the imago escapes from its hard pupa case, and when it has completed its metamorphoses, the digestive canal presents further modifications, which are brought about, however, during the imprisonment. The gullet is longer, and has a sac-like crop projecting from it; the stomach is narrower, and the intestine is longer. All the muscular fibres are extremely delicate, and there are no new arrangements of them. The basement membrane of the gullet is developed on one side into a bag-shaped tissue, and the whole of it is covered by extremely delicate cells, most of which have a long hair-like process sticking up from them, which was foreshadowed by the tooth-like projection of the larva state. The stomach cells have increased in height, and contain granules, but they resemble those of the pupa until the food is taken; then the cells increase in size, and many are set free in a globular form, and there is not a want of likeness between some of them and those of the larva (Fig. 6). This long gullet, crop, and tubular stomach, so flaccid from want of strong muscles, is admirably adapted for the peculiar food of the perfect insect. The sugary fluids of flowers require no crushing and rasping, and not much digestion—so the hairs of the gullet-cells assist in the passage of the syrup down the canal, and the gentle pressure of the delicate muscles of the stomach suffices for its purpose.

To say the least, these are wonderful changes in the same anatomical elements, and they indicate that metamorphosis includes modifications the result of disuse and alterations which bear a prospective relation to the future wants of the altered insect form.

It appears at first sight that this separation into different stages of life is necessary for the insect, and that it must have a time devoted to eating, digesting, and assimilating, a quiet condition devoted to internal changes, and a stage where reproduction can be carried on. But this generalisation fails when it is remembered that some larvæ eat and reproduce, and some imagos reproduce and lead bloodthirsty lives also. It is important to recognise the distinction already hinted at. The growth of the young embryo larva within the egg, and that of the escaped and skin-shedding larva, is progressive, but the descriptions given of the changes in the shape and in the anatomy of the digestive organs of the pupa and imago, prove that they do not depend upon simple progression from elementary condition to complexity. The changes of structure belong to a different order of things to the simple growth of the larva's tissues; they appear to be superadded.

(*To be continued.*)

NOTES

THE Medals in the gift of the Royal Society have this year been awarded as follows:—The Copley Medal has been awarded to Professor Friedrich Wöhler, of Göttingen, For. Memb. R.S., for his numerous contributions to the Science of Chemistry, and more especially for his researches on the products of the decomposition of Cyanogen by Ammonia; on the Derivatives of Uric Acid; on the Benzoyl Series; on Boron, Silicon, and their compounds; on Titanium, and on Meteoric Stones. A Royal Medal has been awarded to Professor Thomas Anderson, M.D., for his investigations on the Organic Bases of Dippell's Animal Oil; on Codeine; on the Crystallised Constituents of Opium; on Piperin and on Papaverin; and for his researches in Physiological and Agricultural Chemistry. A Royal Medal has been awarded to Mr. Henry John Carter, F.R.S., for his long-continued and valuable researches in Zoology, and more especially for his inquiries into the Natural History of the Spongiadæ. The Rumford Medal, awarded every two years, has been awarded [to Anders] Jonas Angström, For. Memb. R.S., for his Researches on Spectral Analysis.

THE annual meeting of the Fellows of the Royal Society, for the election of officers and Council for the ensuing year, will be held, as usual, on the 30th inst. As we have before announced, Dr. Sharpey, after a long period of service as secretary, resigns his functions, which have been of such great advantage to the Society, and by the performance of which he has earned the thanks and respect of all men of science, Prof. Huxley being nominated by the council as his successor.

IN the *Boston Daily Advertiser* for Saturday, Oct. 26, 1872, the conclusion of Prof. Tyndall's last lecture is thus reported:—"There are three great theories which enable the human mind to open the secrets of nature—the theory of gravitation, the mechanical theory of heat, and the undulatory theory of light. These three pillars, as far as the human intellect is concerned, support the universe. To whom are we indebted for these discoveries? To men who had no practical ends in view, and who cared only for the truth. To-day, when there are so many temptations to young men to leave pure science for practical aims, it behoves us to look with sympathetic eyes upon the investigator who makes all this knowledge possible. I met on the steamship *Russia* a respected friend who ascribed the electric telegraph to a source to which I certainly should not have thought of referring it. It is the direct outcome of men who never made a shilling by it. Volta, Faraday, never made a shilling by it. All honour to the men who make these discoveries. Gauss and Weber, at the University of Göttingen, actually constructed a telegraph line from the physical cabinet to the observatory. Give all honour to the men who apply discoveries, but do not forget the men who make them. Many of you in this country have made fortunes, and have shown that you know how to apply them. Look with sympathetic eye upon the investigators. Give them opportunities. Do not overload them with other work. 'Cast your bread upon the waters,' and believe me 'it will return to you after many days.' My course among you is nearly over. I began it with some anxiety and end it with regret. It has been harder for me at times than I had expected, and I owe much to my assistants. I shall long and gratefully remember my reception on the occasion of my first lecture here. If I am treated in the same manner elsewhere, I shall return to the old country full of content. During my stay here I have heard 'the old country' mentioned again and again. You cannot abolish your antecedents. Out of England's loins you have come. Your ancestry is stamped upon your faces, your laws, your politics, and your characters. De Tocqueville, sympathising with democratic institutions, says, regarding England and America: "I refuse to regard these people as two; one is the outgrowth of the other." Atrocious ignorance of each other is at the bottom of all our differences. I trust that hereafter each nation will respect the individuality of the other; while thoroughly maintaining its own.' The lecture was listened to with great attention, and loudly applauded at the close. Every point made in behalf of the investigators, and upon our relations to the mother country, received loud approbation. Our report cannot do justice to Dr. Tyndall's earnestness in the latter portions of his lecture. It is to be hoped that some of our so-called 'practical men' may take to heart the lessons he has tried to teach them."

THE late Prof. De Morgan, in a note to his article on Tables in the "English Cyclopædia," strongly expresses his regret that the British Museum did not purchase Dr. Hutton's valuable mathematical library, and, consequently, the first set of mathematical tables ever collected in England was dispersed. With a view to avert a similar break-up, we may inform our readers that at a very early date the mathematical collections of the late Mr. Babbage must be disposed of. It is with reference to these that De Morgan, in the above-cited article, acknowledges his indebtedness ("large and rare collection of Tables"). Its excellence, however, is not confined to this special department only. We learn that catalogues will be issued in the course of a few days.

IN reference to the Swiney Lectureship, which we announced recently as having become vacant, we venture to hope the post will not be thrown away on some one who is already well off, and has taken his place in life, but that it will be given to some young man who has shown himself well qualified for scientific research, and who may thus be enabled to devote his time to investigations which may lead to results of enduring value. Several eminent men have already held this lectureship, including, we believe, Dr. Carpenter.

PROF. WEISS, of the Vienna Observatory, has recently passed through London, on his return from a tour of inspection through the United States, where he has visited all the principal observatories, in order to collect materials for a report on the instruments demanded by modern science in a first-class observatory like that of Vienna, which is about to be removed and extended. It appears that the 26-inch object-glass ordered by the American Government, as soon as the completion of Mr. Newall's magnificent instrument has established the feasibility of such an enormous aperture, is already finished, and the mounting is in a forward state.

Silliman's Journal for November mentions the death of the Rev. John B. Perry, Professor of Primordial Geology in Harvard College, and of Dr. John F. Frazer, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.

THE death is announced, in the Isle of Wight, on Friday last, of Dr. H. B. Leeson, F.R.S., for many years lecturer on chemistry at St. Thomas's Hospital.

THE University of Aberdeen certainly is not disposed to glect science in looking out for a Lord Rector; among those oken of to be put up for the next election, are Mr. Darwin, of. Huxley, and Dr. Lyon Playfair.

WE are glad to call attention to the fund now being raised for e education and maintenance of the family of Mr. John Cargill ough, subscriptions to which may be paid at Messrs. Robarts d Lubbock's bank. We understand that a considerable nount has already been received.

THE winter course of lectures at South Kensington Museum r the instruction of women in science and art was opened on londay by Prof. Duncan. The course is to consist of three ries—the first by Prof. Duncan, on "Cosmogony and the Vorld as a Planet;" the second by Prof. Carey Foster, on Physics;" and the third by Prof. Rutherford, on "Physiology." There was a large attendance of ladies.

THE Committee of Directors of the Crystal Palace have esolved to extend the uses of that Institution by establishng practical engineering classes, in connection with their chool of Art, Science, and Literature, under the Principalship f Mr. J. M. Wilson, Assoc. Inst. C.E. Such a preparatory ourse will render pupils on entering an engineer's office at nce useful to their employers, and will enable them to take dvantage of the opportunities offered to them during the time hey are articled. These classes have been established for the purpose of affording to students of civil and mechanical engineering the advantage of thorough practical instruction in the rudiments of either profession, and in the manipulation of materials. The classes are also available for gentlemen anxious to become engineering draughtsmen, or to compete for the Whitworth Scholarships, or to enter the Steam Mercantile Marine. The course of instruction will consist of three terms extending over welve months. One term will be spent in the drawing office, one in the pattern shop and foundry, and one in the smith's fitting and erecting shops. The students will be engaged in mechanical drawing, estimating and calculating, pattern-making, and constructing machinery for the market. Lectures will be delivered from time to time by the Principal, or by some eminent professor, on subjects connected with theoretical and practical engineering, and the students will be required to pass an examination upon such lectures at the expiration of each term. Convenient and extensive shops and offices, supplied with the best engineering machinery, have been fitted up for the purposes of the institution. The shops will be finished and the teaching commenced on January 1, or within a few days of that date. The premium for the year's instruction will be fifty guineas. The Crystal Palace is in many respects most suitable for such a purpose; for, irrespective of its being central and easy of access, it contains so many engineering models, works of science and art, hydraulic, pumping, and other machinery, that illustrations of important works in great variety are always accessible.

LORD F. CAVENDISH, M.P., presided on Monday at a meeting of the committee appointed to consider the proposed plans for establishing a College of Science at Leeds. The cost originally estimated was 61,000*l.*; but the funds are not forthcoming, and a committee was appointed to reconsider the subject.

SIR H. C. RAWLINSON, in his inaugural address on Monday night to the Geographical Society, referred to two contemplated African expeditions—one, got up by Livingstone's friends, and called the "Livingstone Congo Expedition," is to ascend the Congo from above the rapids, and endeavour to penetrate to the equatorial lake where Livingstone's rivers are lost, and in the vicinity of which it is expected the great traveller will be found at the close of next year. Livingstone's close friend, Mr. J. Young, of Kelly, has taken upon himself the expenses of the expedition to the amount of 1,500*l.* or 2,000*l.* A rival German expedition has been officially announced as in preparation for the same reason.

THE following numbers are stated to have been sold of Mr. Murray's scientific books at his annual "sale" last week:—6,200 of Mr. Darwin's new work on the "Expression of the Emotions in Man and Animals;" 1,100 of Darwin's "Origin of Species" and other works; 350 of Lyell's "Principles of Geology," 2 vols.; 900 of Lyell's "Students' Elements of Geology;" 1,500 of Kirk's "Handbook of Physiology;" 300 of Sir Roderick Murchison's "Siluria;" 1,200 of Prof. Newth's "Natural Philosophy;" 380 of Whymper's "Scrambles on the Alps."

A TELEGRAM from Copenhagen states that Mr. Edward Whymper has arrived there from his second journey of exploration in North Greenland. He brings with him rich collections of curiosities, among which are some very singular specimens of fossil wood.

THE Conversazione of the Photographic Society was held on Tuesday evening last, and the Annual Exhibition of Photographs will be open at the rooms of the Society, No. 9, Conduit Street, till the 30th inst., from nine till dusk, and on Monday and Saturday evenings.

THE members of the Hunterian Society were received by their President, Dr. Herbert Davies, on Monday evening last, at 23, Finsbury Square. In the course of the evening some original experiments were performed by Prof. Norris, of Birmingham, showing some hitherto unnoticed manifestations of the attraction of cohesion, with a view to explain the possibility of the passage of blood corpuscles through the capillaries in certain morbid states of the body, without the capillaries themselves being destroyed.

ON the evening of November 5 two new planets were discovered at the Paris Observatory. The first, discovered by M. Paul Henry, about 9 o'clock, is of the 11th magnitude; the second, discovered by M. Prosper Henry, is in magnitude 11·5.

PROF. WINLOCK communicates to 1,909 of *Astronomische Nachrichten* carefully tabulated "Results in Right Ascension of Observations of 156 Fundamental Stars observed with the Meridian-Circle of Harvard College University" (in English).

IT may not be generally known, says the *Astronomical Register*, that amongst other works translated of late years into the Chinese language are the following:—Herschel's "Outlines of Astronomy," by Wylie, 3 vols., sm. folio, China, 1859; De Morgan's "Algebra," by the same, 8vo., 1859; Mac Gowan's "Law of Storms," China, 1853; Milner's "History of England," abridged, by Muirhead, Shanghai, 1856. There is also a Treatise on Arithmetic, in Chinese, by Wylie, 1853.

THE committee of the Palestine Exploration Fund have just received a first instalment of the work of surveying the Holy Land. It consists of the first three sheets of an Ordnance map of the country, on the scale of one inch to a mile, based on an accurate trigonometrical survey, and including the district between Jaffa and Jerusalem, and the country north of Jerusalem towards Nablous, and embracing an area of 560 square miles. The survey has been already completed over an area of about 1,000 square miles, and further sheets may be expected about the beginning of the new year.

THE Ninth Report, just issued, of the Belfast Naturalists Field Club, speaks of continued activity and enterprise on the part of the Society. A considerable portion of the report is occupied by accounts of the various excursions, and short abstracts are also given of a number of papers read at its meetings, many of them having a chiefly local interest.

THE BIRTH OF CHEMISTRY

IV.

Iron, lead, quicksilver.—Colours used for painting and dyeing.—Glass.—Certain minerals known to the ancients.—Miscellaneous processes.—Association of the seven metals with the seven greater heavenly bodies.—Consequent introduction of symbols into the history of matter.

IRON was not in common use till long after the introduction of copper. It is far more difficult to procure, because it is not met with in the native state, and the fusing point is very high. The metallurgy of iron is more complex than that of copper, and when obtained it is a more difficult metal to work. According to Xenophon the melting of iron ore was first practised by the Chalubes, a nation dwelling near the Black Sea, hence the name Chalups (χάλυψ) used for steel, and hence our word *Chalybeate* applied to a mineral water containing iron. Steel was known to the ancients, but we do not know by what means it was prepared; it was tempered by heating to redness, and plunging in cold water. According to some, kuanos (κύανος) mentioned by Homer was steel; but Mr. Gladstone prefers to conclude that it was bronze. Iron was known at least 1537 B.C. It was coined into money by the Lacedæmonians, and in the time of Lukourgos was in common use. It was used in the time of Homer for certain cutting-instruments, such as woodmen's axes, and for ploughshares. Its value is shown by the fact that Achilles proposed a ball of iron as a prize for the games in honour of Patroklos. Neither iron money nor iron implements of great antiquity have been found, because, unlike the other metals of which we have spoken above, iron rusts rapidly, and comparatively soon disappears. No remains of it have been found in Egypt, yet Herodotus tells us that iron instruments were used in building the pyramids; moreover, steel must have been employed to engrave the granite and other hard rocks, massive pillars of which are often found engraved most delicately from top to bottom with hieroglyphics. Again, the beautifully engraved Babylonian cylinders and Egyptian gems, frequently of cornelian and onyx, must have required steel tools of the finest temper. We have no record of the furnaces in which iron ore was smelted, but we know that bellows were in use in the 15th century B.C. in Egypt, and some crucibles of the same period are preserved in the Berlin Museum. They closely resemble the crucibles in use in the present day. The accompanying woodcut (Fig. 3) represents a double pair of bellows, a furnace, fuel, and above perhaps a crucible.

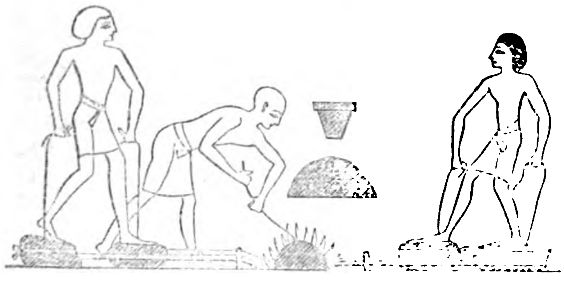

FIG. 3.—Egyptian Bellows. Fifteenth Century B.C.

The native Indians prepare iron from hæmatite at the present time by equally primitive bellows, which indeed resemble the above very closely, and which, without doubt, have been unaltered for centuries. A small furnace, A (see the accompanying section, Fig. 4),* is rapidly constructed of clay, and into the bottom of this two nozzles, B, are introduced; these are connected with the bellows by bamboo tubes. The bellows, C, consist of cup-shaped bowls of wood covered with goat-skin above, and connected with the bamboo below. In the centre of the goat-skin cover a round hole is cut; the blower places his heel upon this, which is thus closed, while at the same time the skin is depressed and a blast is driven from the tube, then he steps upon the second skin, and thus a continual blast is kept up. The bent bamboo and string, D, is for the purpose of raising the goatskin cover of the bellows after depression, which, it will be noticed, is accomplished in the Egyptian bellows by a string raised by the hand. A piece of hæmatite is introduced with some charcoal, and after the lapse of some time, it is reduced by the carbonic oxide to a spongy mass of iron. Undoubtedly a crude furnace and appliance of this nature was used by the first smelters of iron.

Although we hear less of lead than of the preceding metals, it was known to the Egyptians at an early date, and it is mentioned by Homer. In the time of Pliny leaden pipes were used to convey water; and sheet lead was employed for roofing purposes. The chief supply of the metal came from Spain and Britain. Pliny believed that lead was reproduced in the mine, so that if an exhausted mine were closed it would be fit to work again in a few years' time. This idea of the growth of the metals was very generally accepted by the alchemists. Tin and lead were sometimes alloyed together by the ancients, and tin was used as a solder for lead. Litharge, or protoxide of lead, and *cerussa usta* (burnt ceruss), or red lead, were used by painters. *Cerussa*, which we now call "white lead," or more strictly, carbonate of lead, was prepared by exposing sheets of lead to the fumes of vinegar in a warm place, a heap of decomposing manure for instance. A basic acetate of lead is formed by this means, which is partially converted into carbonate by the carbonic acid given off by the decomposing organic matter. Cerussa was used by Athenian ladies as a cosmetic. Cerussa usta was first formed accidentally from cerussa during the burning of a house near the Piræus. Litharge is easily formed by heating lead above its melting point in air, when it absorbs oxygen gas, and the resulting oxide may be skimmed off.

Mercury was common in the time of Pliny, but it is not mentioned by earlier writers. It was found native in Spain, but was more generally obtained by heating cinnabar (sulphide of mercury) with iron filings in an earthen vessel, to the top of which a cover was luted. The iron decomposed the sulphide, and the liberated mercury was volatilised and condensed on the cover of the vessel, whence it was collected. This method, described by Dioscorides, is the first crude example of *distillation*, which afterwards became a principal operation among the alchemists and chemists for separating the volatile from the fixed. In the time of Dioscorides cinnabar was called *minium*, but it became so largely adulterated with red lead that the term minium was ultimately applied to the latter. Minium is still one of the names for red lead. Pliny was acquainted with the high specific gravity of mercury, and with its power of dissolving gold. Substances were sometimes gilded by a gold amalgam. Mercury was also used, as now, for extracting gold from its earthy matrix; the gold-bearing rock was powdered and shaken up with mercury, which dissolved out the gold; the amalgam of gold and mercury was then squeezed through leather, which separated most of the mercury; the solid amalgam was heated to expel the mercury, and pure gold remained. Vitruvius states that gold was recovered from gold embroidery by burning the cloth in an earthen pot and throwing the ashes into water to which quicksilver was added. The latter attracted the gold and dissolved it; the amalgam was put into a piece of cloth and squeezed between the hands, and the mercury, on account of its fluidity, was forced through the pores of the cloth, while the gold remained.

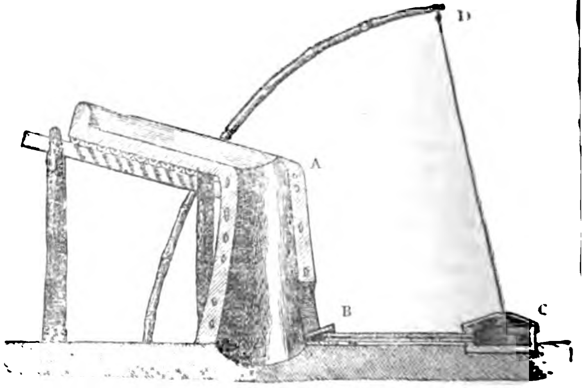

FIG. 4.—Smelting Furnace and Bellows used by native Indians in the present day.

Native mercury was called *argentum vivum* (quicksilver), while mercury distilled from cinnabar was called *hydrargyrum* ωράργυρον, liquid silver), from which we take our present mbol for the metal, *Hg*. The alchemists, among whom, as we all hereafter see, mercury was a very principal metal, call it by various names of *mercurius*, *argentum vivum*, *hydrargyrum*, th others of a more fanciful nature.

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* We are indebted to Dr. Percy for permission to copy this figure from his "Metallurgy," and to Mr. Murray for the other woodcuts.

The ancients were not acquainted with any other metals in an combined state, except the seven mentioned above. *Stibium* sulphide of antimony, was used in the East at an early period r painting the eyelashes. It is still used for that purpose, and is lled *kohl*. Native carbonate of zinc was known, and black oxide manganese. The two sulphides of arsenic were known, and ere used as pigments. The yellow sulphide was called *auri-gmentum* and *arsenicum*; the red sulphide went by the name *sandaracha*. Auripigmentum became contracted into *orpi-ent*, a word which we find both in alchemical treatises and in ur most modern treatises on chemistry.

The colours used by the ancients for painting were examined y Sir Humphry Davy at the beginning of this century, and he ame to the conclusion that "the Greek and Roman painters ad almost all the same colours as those employed by the great talian masters at the period of the revival of arts in Italy." arious colours have been examined from the frescoes in he Baths of Titus, from Pompeii, and from Egyptian tombs. The colours of the Egyptians were red, yellow, blue, green, black, and white. The red was bole, that is a clay deriving its colour from oxide of iron; the yellow an ochre, also clay, coloured by a paler form of oxide of iron; the green a mixture of this ochre with a blue powdered glass, produced by using together sand, carbonate of soda, and oxide of copper. The black was ivory black, prepared by heating bones out of contact with air until completely carbonised; the white was powdered chalk. These various colours were mixed with gum and water before use. The Greeks and Romans used red lead and cinnabar, as well as red ochre, and yellow protoxide of lead. The blue powdered glass mentioned above was called *κύανος* by the Greeks, *Cæruleum* by the Romans. Vitruvius describes the method of preparing it; and Davy prepared a substance which perfectly resembled the ancient colour, by fusing together fifteen parts of carbonate of soda, twenty parts of powdered flints, and hree parts of copper filings. The green of the Romans was carbonate of copper, and for browns they sometimes used dark oxide of iron, sometimes oxide of manganese. The *purpurissum* of the Romans was Tyrian purple, a very valuable colour obtained from a shell fish, and much used for dyeing. In order to obtain the colour for the purposes of painting, clay was placed in the chaldrons of dye, so as to absorb the colour, and was afterwards removed and dried. *Indicum purpurissum* was probably indigo; Pliny mentions that the vapour possesses a fine purple colour. Ivory black was called *Elephantinum*; lamp black, that is soot, was called *Atramentum*. The latter mixed with water constituted the ink of the ancients.

According to Pliny, glass was first discovered by some Phœnician merchants who were returning from Egypt with a cargo of *natron* (carbonate of soda), and who landed on the sandy banks of the river Belus. In order to support the vessels they used for cooking their food over the fire, they used some large lumps of natron, and the fire was sufficiently strong to fuse it, with the fine sand of the river. Hence resulted the first glass. Whatever may be the value of this story, we find representations of glass-blowing on the monuments of Thebes and Beni Hassan; and the Egyptians were well acquainted with it 2450 B.C. The most celebrated manufactory of glass was in Egypt; and, according to Strabo, a peculiar kind of earth found near Alexandria was essential for the finer kinds of glass. The Egyptian glass had nearly the same composition as our "crown glass," which contains 63 per cent. of silica, 22 of potash, 12 of lime, and 3 of alumina. The Phœnicians and Egyptians exported large quantities of glass to Greece and Rome. The Egyptians engraved and cut glass with the diamond; they also possessed extraordinary skill in colouring glass with various metallic oxides, and combining several colours in the same vase, and they imitated precious stones with great success. We read of whole statues made of emerald, but these were undoubtedly of emerald glass, viz., glass coloured by oxide of copper. The Egyptians understood the art of enamelling on metals. Aristophanes is the first Greek author who mentions glass (τὴν ὕαλον); he alludes to the use of a lens of glass, as a burning-glass in the Νεφέλαι, which play was acted in Athens, B.C. 423. Colourless glass was the most valuable, and a small quantity of oxide of manganese was added then as now for the purpose of decolourising it. A very ancient opaque green glass, analysed by Klaproth, was found to contain 65 per cent. of silica, 10 of oxide of copper, 7·5 of oxide of lead, 3·5 of oxide of iron, and about 6 per cent. of both lime and alumina. A red glass was found to be coloured by red oxide of copper.

Dyeing was well understood by the ancients; the Egyptians understood the effect of acid on some colours, and were acquainted with mordants, that is, substances which "fix" the colouring matter in the fabric, and prevent it from being washed out. The most celebrated dye of antiquity was the purple of Tyre, discovered about 1500 B.C., perhaps earlier. It was produced by certain shell fish which inhabit the Mediterranean; these are spoken of as *buccinum* and *purpura* by Pliny. A few drops only of the dye were obtained from each fish, and the colour hence became very valuable, and was monopolised by the emperors of the world. The Egyptians dyed linen with indigo, which they procured from India, for they had considerable intercourse with that country at an early period.

Lime was used for removing the hair from skins about to be tanned. Leather made in the time of Sheshonk, the contemporary of Solomon, has been found in a good state of preservation. For the process of tanning, they used the pods of the Acacia Nilotica, a plant which, according to Sir G. Wilkinson, was also prized for its timber, charcoal, and gum.

Nitrum was a term applied to carbonate of soda, or natron, which, we have already seen, was used in the manufacture of glass. The substance which we now call *nitre* (nitrate of potash) was probably known in India and China before the Christian era. Dr. Thomas Thomson has suggested that when the real nitre was imported into Europe, it received the same name as carbonate of soda (nitrum) from the similarity of its appearance, and retained the name on account of its greater importance. Roger Bacon always speaks of nitrate of potash as nitre. The low Latin name for soda became *natrium*, hence our present symbol for sodium, *Na*.

Soap is first mentioned by Pliny; it was made by mixing wood ashes, which contain carbonate of soda, with animal fat. It was used solely as a kind of pomatum. The Greeks added wood ashes to water to increase its cleansing properties.

The only acid with which the ancients were acquainted was acetic acid, or vinegar. It has been suggested that the Egyptians discovered nitric acid and nitrate of silver, because a silver stain has been found upon some linen, but the evidence is insufficient. We remember the story about Cleopatra dissolving two pearls, valued at ten millions of sestertii, in vinegar; although only a story, it would seem to show that vinegar was the most powerful solvent known. This is further indicated by the story of Hannibal dissolving rocks by vinegar.

A number of minerals are mentioned by Pliny, but we can recognise but few of them. Iron pyrites (sulphide of iron) was used for striking fire with steel in order to kindle tinder, and was hence called pyrites (πῦρ, fire), or fire-stone. Sulphur was well known, and was used for matches; it was also apparently burnt in a current of air, and the sulphurous acid produced employed for bleaching purposes. Asphalt was used for embalming, and undoubtedly also for torches.

Thus far we have become acquainted with the various theories of the Ancients, in which changes in the composition of matter are discussed, and with various processes by which changes were actually effected. Before we leave the Ancients, and pass at one bound to the eighth century A.D., we must notice the commencement of a symbolical system in the history of matter, which in the hands of the Alchemists and early Chemists assumed vast proportions, and still appertains to the science of Chemistry. This system was commenced by the association of the seven metals with the seven greater heavenly bodies. We do not know at what period the metals were designated by the names and symbols of the planets: certainly at a very remote age.

At a very early date the Chaldæans represented the stars by symbols, and these gradually increased until astrology became one mass of symbols. On the occasion of certain religious ceremonies the Kings of Assyria wore a necklace in which the sun, moon, and stars were represented as emblems, for they were first worshipped as emblems of the Deity. Sculptural representations of necklaces with seven discs upon them have also been found. Symbols were carried before Egyptian priests, and their gods were represented with certain signs symbolical of their special attributes. The Assyrian goddess Astarte, carries in her left hand a symbol, (*b*) (Fig 5.) not very different from the *crux ansata* of the Egyptians (*a*); and the symbol (*c*) by which the planet Venus was afterwards represented by the astrologers and is still represented by astronomers. In the celebrated "Book of the Dead" (B.C. 1350), the most perfectly preserved Egyptian ritual which the world possesses, this latter symbol (*c* in the figure) occurs frequently among the hieroglyphics. This is very noticeable in the "Judgment scene" of the Turin papyrus, a copy of which exists in the British Museum. The upper portion of the *crux ansata* was frequently made more rounded in form, and it is obvious that if in addition to this the cross was somewhat lowered, we should arrive at the third symbol (*c*) shown above. The *crux ansata* (*a*), if written quickly, could easily pass into this latter symbol (*c*), and this may account for the occurrence of both symbols in the judgment picture, to which we have alluded above.

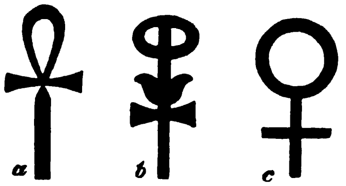

FIG. 5.—*a* Crux ansata of the Egyptians; *b* Assyrian symbol of Astarte; *c* Later symbol of the planet Venus.

Plato speaks of the sun, moon, and five planets, but does not distinguish them by the names of gods; Epinomis mentions them in conjunction with the names of gods. It is probable that the Chaldæans also associated the principal heavenly bodies with the names of deities—San with the sun, Hurki with the moon, Bel Merodach with Jupiter, Astarte or Ishtar with Venus, Nergal with Mars, &c. The relative position of the planets was generally as follows: the Earth was the centre of the system; next in order came the Moon, the Sun, Venus, Mercury, Mars, Jupiter, and Saturn; but these positions were sometimes varied. It was known that Saturn completed a revolution in about thirty years, while Jupiter required twelve years, Mars only two, and Mercury and Venus occupied about the same time as the Sun; hence the above order. As Saturn was farthest from the source of heat, and the slowest in his motion, he was supposed to be of an icy character, and to assert an evil influence.

While speaking of the seven greater heavenly bodies, and the seven metals, we may allude incidentally to the curious prominence of that number in many matters—"that mysterious number," as Mr. Layard calls it, "so prevalent in the Sabæan system." Thus (to select a few instances at random) we have seven days of the week, seven wise men of Greece, seven wonders of the world, seven cardinal sins, seven-stringed lyre, seven harmonic proportions, seven heavens, seven walls of Ecbatana, seven gates of Thebes. The list might be extended almost indefinitely. Among the Hebrews the number was specially prominent. Not to mention the frequent allusion to it in the Apocalypse, we may recall the incidents of the fall of Jericho: the town was surrounded for seven days; on the seventh day the walls fell at the blast of seven trumpets, which were carried round the walls seven times by seven priests.

We cannot tell why the seven metals were associated with the seven deified heavenly bodies, unless it was because all things which amounted to the same number were connected with them. This, at least, we know, that long before the time of Geber, the first writer on chemistry, the metals had received the same names and symbols as the planets. "There is abundant evidence," says Mr. Gladstone, "of a correspondence between the seven metals of Homer and the seven metals of the ancient planetary worship of the East." In the time of Homer only six simple metals were known, and the seventh was the compound *kuanos*; quicksilver afterwards became the seventh simple metal, and received the name and symbol of the seventh planet. The metals were apportioned as follows:—

Gold . . .	The Sun	☉
Silver . . .	The Moon	☽
Quicksilver . .	Mercury	☿
Copper . . .	Venus	♀
Tin	Jupiter	♃
Iron . . .	Mars	♂
Lead . . .	Saturn	♄

Herodotus tells us that Ecbatana had seven walls, the outermost of which was the lowest, and the others gradually ascended like steps to the highest, which enclosed the king's palace. They were each painted of a particular colour; the outermost white, the second black, the third purple, the fourth blue, the fifth red, the sixth the colour of silver, the seventh the colour of gold. Undoubtedly these had reference to the seven greater heavenly bodies. It is impossible to account for the colours, but it is curious to notice the particular colour which would fall to any particular metal. Placing the planets in order as applied to the metals, we should have gold to gold, silver to silver, red to copper, blue to iron, purple to tin, black to lead, the most despised of the metals. It is probable that the Sabæans associated these colours with the seven heavenly bodies. The temple of Bel-Merodach, rebuilt by Nebuchadnezzar, and called by him the "Wonder of Borsippa," appears also to have consisted of seven terraces differently coloured. The following is a portion of the inscription from a clay cylinder found among the ruins of the temple:—"I (Nebuchadnezzar) have completed the magnificence of the tower with silver, gold, precious stones, enamelled bricks, fir, and pine. . . . This most ancient monument of Borsippa is the house of the seven lights of the earth."

How the symbols conferred upon the planets and afterwards upon the metals arose it is difficult to say; they are undoubtedly of Chaldæan origin, but to what extent they have since been modified no one can tell. They exist in early MSS. on Alchemy. That the sun should be represented by a circle, the symbol of perfection, is no wonder. Again, that the moon should be symbolised by a crescent we can understand; but the others present greater difficulties. Among these, some say we have the looking-glass of Venus, the thunderbolts of Jupiter, the spear and shield of Mars, the scythe of Saturn, and the caduceus of Mercury. In the temple of Hermes at Pselcis he is represented with a staff having a serpent twining around it, from which it has been suggested the caduceus of Mercury may have been derived. Some see in ♃, not the thunderbolts, but the throne of Jupiter; others the *Zeta* of Zeus; others, again, the Arabic 4, indicating that Jupiter was the fourth planet in order. Some, too, have seen in ♄ the K of Kronos. It is less difficult to understand why a particular metal was assigned to a particular heavenly body. Thus gold would naturally be associated with the sun, on account of its colour, perfection, and beauty, and because it was ever regarded as the noblest metal. For the same reason silver would fall to the moon, with its pale, silvery colour and light. So, again, iron, the metal of war, would be associated with Mars; lead, the dull, despised metal, with Saturn, the slowest of the planets; quicksilver, the nimble volatile metal, with Mercury, the messenger of the gods.

These signs became in the hands of the Alchemists the commencement of a symbolic system in chemistry.

(*To be continued.*) G. F. RODWELL

SOCIETIES AND ACADEMIES

LONDON

Royal Geographical Society, Nov. 11.—Major-General Sir H. C. Rawlinson, president, in the chair. The President in his inaugural address, recapitulated the leading incidents which have occurred in the exploration of Africa since June, at which time we were in receipt merely of a brief telegraphic announcement that Mr. Stanley had arrived at Zanzibar with despatches, having left Livingstone alone and well at Unyanyembe; and stated that, as the Society honestly consider Mr. Stanley's journey to Lake Tanganyika to be in its results the most important geographical achievement of the year, they feel that, in awarding him their medal, they are only discharging their strict duty, while at the same time they are doing honour to Livingstone and promoting the great end of African discovery. The President then passed on to the history of the Society's own Relief Expedition, touching which he said:—"Much disappointment was felt at the abrupt termination of this expedition. The committee of the Geographical Council charged with the management of the Search and Relief Fund, after a most patient investigation, delivered two reports to the subscribers, the purport of which was that they disapproved of the conduct of Lieutenant Dawson in breaking up the expedition, and that they attributed it to a lamentable error of judgment that he did not carry on to the Doctor, as supplementary to Stanley's relief, a supply of arms, instruments, medicines, and other articles of which he manifestly stood in need. The judgment delivered by the committee has since been greatly fortified by letters written by D

ngstone on July 1st, in which, in answer to his son's letters
Zanzibar, he deplores the break-up of the expedition,
ving how valuable would have been to him the arrival
he officers at Unyanyembe, and he proposed subse-
ntly to have utilised their services. At the same time,
only fair to Lieutenant Dawson to say that no imputa-
whatever rests upon his courage or his honour.
it be understood, once for all, that there is not the remotest
und for questioning the accuracy of Mr. Stanley's statement.
positively certain that Stanley and Livingstone met at Ujiji
time last year, that they travelled on an exploring journey
nd the northern end of Lake Tanganyika, and subsequently
e down together to Unyamyembe, where the Doctor still was
the date of his last despatches." Referring to the sufferings
lergone by Livingstone, the President said, "it is not therefore
prising that, while smarting under his losses and injuries, he
uld have reflected with some bitterness on Dr. Kirk, the
ting-Consul at Zanzibar, who was more or less concerned in send-
off the supplies, and in selecting the agents to be employed."
ter alluding to the complete reconciliation which it is hoped
now been effected between Livingstone and Kirk, the
esident at some length entered into Livingstone's geographical
earches, and arrived at these conclusions:—"There can
no reasonable doubt that this great water-system of Central
frica belongs to the Congo and not to the Nile. The proofs of
e identity of the Lualaba and the Congo, derived from a com-
rison of height-measurements, of volume of water, of the
riodical rains and rise of the rivers, &c. have been put to-
ether very clearly in a paper by Dr. Behm, which has just ap-
eared in the current number of Petermann's 'Mittheilungen,'
nd many arguments arising from local information, as well as
om coincidences of natural history and ethnology, might be
dded in corroboration. The only impediment, indeed, to a full
nd clear understanding on this point is the remarkable fact that,
lthough Livingstone had followed down the gradual slope of the
ualaba from the high plateau where it rises, 5,000 or 6,000 feet
bove the sea-level, to a point where the barometer gave an eleva
ion of only 2,000 feet—that is to a point depressed 1,000 feet
elow the parallel Nile basin to the eastward; and although the
onstant trending of the waters to the west haunted him with misgivings, still he clung tenaciously to his old belief that he must be on the track of the Nile, and even speculated on the possibility of the great river he was pursuing debouching by the Bahr-el-Ghazal. It must be borne in mind, however, that Livingstone in his African solitude had no knowledge of Schweinfurth's discoveries. He had no idea that one, or perhaps two, watersheds intervened between the Lualaba and the head-waters of the Bahr-el-Ghazal; nor does he seem to have been aware that his great river at Nyangwé contained 19 times the volume of water contributed by the western affluent of the White Nile. When this revelation breaks on him, it is not too much to suppose that he will abandon his Nile theory, and rest satisfied with the secondary honour—if indeed it be secondary—of having discovered and traced the upper course of the Congo, which is emphatically called by the natives 'the great river' of Africa." The president then spoke of the "Livingstone Congo Expedition," to which we refer in another column. "The deputation of Sir Bartle Frere on a mission to Zanzibar for the suppression of the slave trade, of which Livingstone may hear before he leaves the vicinity of Lake Tanganyika, will be to him an event of the intensest interest, and may thus have an important influence on his future movements. It is not impossible that Lieut. Cameron might fall in with Baker's flotilla on the Albert Nyanza, as reports have reached us, though not as yet officially confirmed, that Sir S. Baker had pushed on during last summer with a flying column from Gondokoro to the point where the Nile leaves the Nyanza, and had made arrangements for his steamer and boats to be brought up in carts."

Linnean Society, Nov. 7.—Mr. G. Bentham, president, in the chair. On the buds developed on leaves of *Malaxis*, by Dr. Dickie. These buds, developed chiefly on the margins of the leaves of *Malaxis paludosa*, are of interest from the very remarkable resemblance which they bear to the ovules of Orchids, representing an embryo enclosed in a loose enveloping testa.—On the "Piopio" of New Zealand (*Keropia crassirostris* Gmel), by T. H. Potts.

Chemical Society, Nov. 7.—Prof. Williamson, F.R.S., in the chair. Papers were read by Mr. C. E. Stanford, on "the action of charcoal on organic nitrogen," being an account of his experiments to ascertain the value of a method of deodorising and utilising fish-offal and other offensive matters by mixing them with charcoal; and "on Iona pebbles."—A communication entitled "Mineralogical Notices," by Prof. Storey Maskelyne and Dr. Flight, was then read by the former, giving a short description of several minerals mostly new or from fresh localities.—Mr. J. R. A. Newlands gave a brief explanation of "a means of preventing explosions in coal-mines," which the author proposes to effect by erecting air-tight chambers over the upcast and downcast shafts, and forcing air through the workings by powerful air pumps or ventillating fans.—There were also papers "on the specific heat of occluded hydrogen," by W. C. Roberts, and Dr. C. R. A. Wright, and "on some probable reactions that yielded negative results" by Dr. C. R. A. Wright. A specimen of bromocamphor was exhibited by Mr. Williams, of the firm of Hopkin and Williams, who stated that it was used medicinally as a nerve sedative, in such diseases as *delirium tremens*.

Entomological Society, Nov. 4.—Prof. Westwood, president, in the chair. Mr. S. Stevens exhibited an example of *Pieris Daplidice*, and six of *Argynnis Lathonia*, captured by himself in the autumn, at Dover; also, from the same locality, varieties of *Pyrameis cardui*, and *Callimorpha dominula*; *Sesia asiliformis*, *Chærocampa celerio*, and *Deilephila livornica* from Brighton; and a dark variety of *Pieris rapæ* from Ireland. Mr. F. Smith exhibited a large collection of *Formicidæ* sent from Calcutta by Mr. Rothney. He also exhibited, and presented to the Society, the minute-book of the old Entomological Society, containing records of the meetings between 1806 and 1822; incorporating also the minutes of the pre-existing Aurelian Society—this had been given to him by Dr. J. E. Gray. Mr. Butler exhibited the impression of the wing of a butterfly in Stonesfield slate; it was remarkably perfect, and approached nearest to the existing South American genus *Caligo*. Mr. Davis exhibited a large collection of beautifully preserved larvæ of various insects. Mr. Davis exhibited a collection of drawings illustrating the transformations of Indian *Lepidoptera*. He also remarked concerning the habits of the common gnat; from July to the present time he had, every day, found swarms of this insect in his house, all being females, which sex only is capable of inflicting painful bites; the windows were constantly closed, yet each day a fresh swarm appeared to replace those destroyed, and he could not account for their appearance, unless they (as he thought probable) came down the chimneys. Mr. Müller read notes on the habits of a small beetle allied to *Anobium*, which he had bred from a large oak-gall from California. The Rev. R. P. Murray communicated notes on variations in the neuration of certain *Papilionidæ*. A further portion of the proposed general Catalogue of British Insects, comprising the *Ichneumonidæ*, *Braconidæ*, &c. compiled by the Rev. T. A. Marshall, was announced as published, and notes thereon by Mr. Marshall were read.

Anthropological Institute, Nov. 5.—Dr. R. S. Charnock, vice-president, in the chair. A paper was read on "Man and the Ape" by Mr. C. Staniland Wake. After referring to the agreement in physical structure of man and the ape, and to the fact that the latter possesses the power of reasoning, with all the faculties necessary for its due exercise, the author proceeded to show that it is incorrect to affirm that man has no special mental faculty. He has a spiritual insight or power of reflection which enables him to distinguish qualities and to separate them as objects of thought from the things to which they belong. All language is in some sense the result of such a process, and its exercise by even the most uncivilised peoples is shown in their having words denoting colours. The possession by man of the faculty of insight or reflection is accompanied by a relative physical superiority. The human brain is much longer than that of the ape, and he has also a much more refined nervous structure, with a naked skin. The author here showed that the only physical fact absolutely necessary to be accounted for is the great size of the human brain, and this could not be done on the hypothesis of natural selection. Mr. Wallace's reference, on the other hand, to a creative will really undermines Mr. Darwin's whole hypothesis. After referring to the theories of Mr. Murphy and Haeckel, the author stated that the only way to explain man's origin, consistently with his physical and mental connection with the ape, is to suppose that nature is an organic whole, and that man is the necessary result of its evolution. While man, therefore, is derived from the ape, as supposed by Mr. Darwin, it is under conditions very different from those which his hypothesis requires. According to this, the appearance of man on the earth must have been in a certain sense accidental; while, according to the author's view, organic nature could only have been evolved in the direction of man, who is the necessary result of such evolution, and a perfect epitome of nature itself.

PARIS

Academy of Sciences, Oct. 28.—M. Faye, President.—The first paper was a long reply to M. Pasteur's late paper on the production of wine, by M. Fremy; at its conclusion M. Pasteur rose and defended his former position, after which M. Fremy again returned to the attack, on the conclusion of which M. Pasteur contented himself with saying that he had already answered all objections. M. A. Trécul then read a note on the origin of Ferments, on the conclusion of which M. Pasteur made a few remarks, and the discussion dropped.—M. Yvon Villarceau next read a paper on a new general mechanical theory. M. Chevreul followed with the conclusion of his answer to M. A. Gruyer's report on the London International Exhibition of 1871. MM. P. A. Favre and C. A. Valson's researches on crystalline dissociation came next. They concluded this, the third paper, as follows:—"The result of solution is to give to the elements of the dissolved bodies a reciprocal independence, and the internal mechanical work necessary to produce this effect is measured by the changes of volume which accompany solution, and consequently by the quantity of heat brought into play when the same effects of force are applied directly to the dissolving liquid by means of equivalent actions."—M. Is. Pierre and E. Puchot followed with a paper entitled "New Studies on valeric acid, and on its preparation on the large scale." The authors assert that valeric acid rotates the plane of polarisation in the same direction as cane sugar, while amylic alcohol rotates it in the opposite direction. A paper on butyric acid, by the same authors followed. The acid, prepared from butyric alcohol, exerts no sensible action on polarised light; it boils regularly at 155·5, when the barometer stands at 760 M.M.—A paper on the extension of the *Phylloxera* in Europe, by M. J. E. Planchon, was then read. The author states that the insect is indigenous to America, and that it is a recent importation into Europe.—A memoir by M. Resal on the equation of movement of a funicular curve, &c., was referred to the section of mechanics, and was followed by an essay on the theory of running streams, by M. Boussinesq.—A paper by Mr. Grace Calvert on the power possessed by certain substances of stopping putrefaction and the development of protoplasmic life, was then read, after which came the second of M. Dareste's studies on the osteological type of osseous fish; it was referred to the zoological and anatomical section.—M. Dumas then read some communications from the *Phylloxera* Commission, which received at this meeting a communication from M. Loarer.—The Lightning Conductor Commission received five reports from M. W. de Fonvielle, who is charged with a mission to England by that commission. A memoir on fevers by M. P: Levers was sent to the commission for administering the Bréant legacy, and that on the preservation of articles of food received a paper from M. Lacc.—M. Yvon Villarceau then presented M. Stephan's Observations and Ephemerides of the planet 123.—Then came some new observations on Summit and Thalweg Lines, by M. C. Jordan,—A note by M. H. Delray on the purple of Cassius was then read. The author proposes the following definition of this body, the true constitution of which has not yet been satisfactorily determined. He says that purple of Cassius is a lake of stannic or melastannic acid coloured with finely divided gold, and that the latter has, by reason of its combination with the tin oxide, lost its solubility in mercury, just as many colouring matters become insoluble as soon as they encounter vegetable fibre. He adduces several experiments in support of this view.—A note from M. H. Violette on the Fusion of Platinum followed. The author has fused platinum in a wind furnace connected with the chimney-shaft of a large factory, and fed with gas-carbon in small fragments. 50 grammes were thus fused in an hour, but one of the secretaries of the Academy suggests that the platinum was contaminated with the carbon or silicon, and thus rendered abnormally fusible. M. de Quatrefages then presented a note by M. de la Blanchière on changes of colouration produced in fish by the conditions of their *habitat*, after which M. C. Sedillot presented some researches on the physiological and anti-fermentescible properties of sodic silicate, by MM. A. Rabuteau and F. Papillon; these further experiments confirm the author's previous results, with the exception that in some cases the action on ferments is only temporary. The author hopes to be able to explain this retarding action of the silicate in a future communication.—This paper was followed by one on some chemical researches on the leaves of *Eucalyptus globulus*, by M. Rabateau. These leaves are used as an antiperiodic, and the author endeavoured to find in them an alkaloid, but did not succeed.—M. Ch. Grad then read a paper on the quaternary formations of the Algerine Sahara, and was followed by M. A. Béchamp with a paper on some researches on the physiological theory of the alcoholic fermentation produced by beer yeast. The researches of the author tend to support the physiological and not the chemical theory.—M. Jacquez then demanded the opening of two notes deposited by him on the 23rd November, 1857, and 4th January, 1858. The notes related to the action of borates in preventing putrefaction and the growth of mould and their use as an injection for subjects for dissection; the conclusion arrived at in the first note is, that these salts are extremely efficacious for the above purposes.—A note by M. Guynemer, deposited on the 3rd of January, 1870, and relating to the November meteorites, was next opened.—A note by M. Malessart on a new motive power obtained by a particular disposition of electro magnets, was submitted to M. E. Becquerel for examination.—M. Lamson presented some drawings of a machine, the motive power of which was produced by the action of gravity. They were submitted to M. Dupuy de Lôme.—M. F. Thomas sent a note on the production of fluorine by the action of cupric sulphate on an anhydrous fluoride, which was submitted to M. Balard.

BOOKS RECEIVED.

ENGLISH.—The Forms of Water in Clouds and Rivers, Ice and Glaciers: J. Tyndall (H. S. King and Co.).—Elementary Treatise on Natural Philosophy: A. Privat Deschanel, translated by Prof. J. D. Everett (Blackie and Son).—Notes on River Basins: E. R. Williams (Longmans).

DIARY

THURSDAY, NOVEMBER 14.

LONDON MATHEMATICAL SOCIETY, at 8.—Remarks on some Recent Generalisations of Algebra: the President.—Sur les Fonctions Circulaires: M. Hermite.—Investigation of the Disturbance produced by a Spherical Obstacle on the Waves of Sound: Hon. J. W. Strutt.—On the Mechanical Description of a Cubic Curve: Prof. Cayley.—A Series of Models of Cubic Surfaces to Illustrate their Different Forms: Prof. Henrici.—On a Theorem Relating to the Polyedra with Triangular Faces, with Illustrative Models: Prof. W. A. Clifford.

SUNDAY, NOVEMBER 17.

SUNDAY LECTURE SOCIETY, at 4.—On the Dawn of the Science in Europe: Prof. W. K. Clifford.

MONDAY, NOVEMBER 18.

ENTOMOLOGICAL SOCIETY, at 7.

TUESDAY, NOVEMBER 19.

ZOOLOGICAL SOCIETY, at 8.30.

ANTHROPOLOGICAL INSTITUTE, at 8.—The Moabite Jars, with a Translation: Rev. Dunbar I. Heath, M.A.—Human Remains from [illegible]: Capt. Burton and Dr. Blake.—The Atlantean Race of Western Europe: the late J. W. Jackson.

WEDNESDAY, NOVEMBER 20.

GEOLOGICAL SOCIETY at 8.—On the Geology of the Thunder Bay and Shabendowan Mining Districts, on the North Shore of Lake Superior: Dr. Alleyne Nicholson, F.G.S.—On the Relations of the supposed Carboniferous Plants of Bear Island with the Palæozoic Flora of North America: Dr. J. W. Dawson, F.R.S.—Further Notes on Eocene Crustacea from Portsmouth: H. Woodward, F.G.S.—On a New Trilobite from the Cape of Good Hope: H. Woodward, F.G.S.

METEOROLOGICAL SOCIETY, at 7.—On the Storms experienced by the Submarine Cable Expedition in the Persian Gulf, Nov. 1 and 2, 1869: Latimer Clark, M. Inst. C.E.—On the Meteorology of Southland, New Zealand, in 1871: C. Rous Marten.—On a Self-registering Tide-gauge and Electrical Barograph: H. C. Russell, Government Astronomer, Sydney.

THURSDAY, NOVEMBER 21.

LINNEAN SOCIETY, at 8.—On the *Compositæ* of Bengal: C. B. Clarke, F.L.S.—On Diversity of Evolution under one set of External Conditions: Rev. J. T. Gulick.

CHEMICAL SOCIETY, at 8.

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THURSDAY, NOVEMBER 21, 1872

MR. BESSEMER'S SALOON STEAMER FOR THE CHANNEL PASSAGE

THE prevention of sea-sickness by means of a swinging cabin has nothing novel about it, but the originality and inventive merit in the suspended saloon devised by Mr. Bessemer, and now about to be actually constructed in a ship specially designed for it by Mr. Reed, the late Chief Constructor of the Navy, are of the highest order. The association of those names is in itself a sufficient guarantee that the idea will be carried into execution with complete security as respects the safety of the passengers and the seaworthiness of the ship, and a full knowledge of the scientific principles involved.

Persons suffering from sea-sickness complain not only of giddiness arising from themselves and everything about them being continually in motion, but also in particular of a qualm which comes over them every time the ship, or the part of it on which they are standing, is descending, sinking, as it were, from under their feet. An approach to this qualm is commonly felt in a garden swing during the descent, and also in jumping from considerable heights. There can be very little doubt that this is due to the fact that the intestines are then wholly or partially relieved from their own weight, and therefore exercise an unusual pressure against the stomach, liver, and diaphragm. This pressure produces the qualm, and its rapid and frequent alternations cause sufficient irritation to produce in most people sea-sickness, and in some persons more serious effects. Physiologists are by no means agreed as to how much of sea-sickness is due to this cause, and how much to the reaction upon the stomach of the brain-disturbance, due in part, perhaps, to the actual motion of the head, but largely to the optical effect of the motion. It is pretty certain that all these causes contribute to produce the effect of sea-sickness. It is beyond doubt that they all aggravate it.

Mere swinging cots or small cabins go but a very little way to remedy any of these evils. Even if suspended in two directions, like a compass or barometer upon jimbals, the translatory motion, whether up or down, or to and fro, remains wholly unaltered, and even the oscillatory motion is not got rid of, but only altered in character, being reduced to a minimum at a point near the middle of the ship. The distressing effect upon the eye of the relative motion of surrounding objects also remains. These effects will not be wholly eliminated by Mr. Bessemer's invention; but some of them will be very much reduced, and it remains to be seen whether the reduction is sufficient to get rid of the sickness.

The design, as settled by Mr. Bessemer and Mr. Reed, includes the construction of large steam vessels of light draught, 350 feet long, 40 feet beam, drawing 7 feet of water, and worked by two pairs of paddle-wheels. In the middle of each of these is provided a well, or hole, for the reception of a saloon 70 feet long, 20 feet wide, and 20 feet high, constructed so as to form a box girder in itself, and suspended at its extremities upon a pair of trunnions, on which it can turn, so that it may be kept steady as the vessel rolls from side to side. The saloon is not allowed to swing quite freely, but its motion is controlled by hydraulic machinery, acting either upon a rocking arm or a tangent bar (it does not appear as yet which has been selected), which enables a man to regulate its position at his discretion. This man sits opposite a spirit level, and, by merely turning a handle which opens certain valves, can keep the bubble of the spirit level at zero, so as to keep the saloon virtually upright at all times. The chief novelty of the invention consists in two points—the great size of the swinging cabin or saloon, and the controlling of its motion by hand, instead of trusting to self-adjustment. Both these are very important improvements on the simple swinging cabin.

This attempt to neutralise the motion of the vessel addresses itself to one phase of motion only, namely the rolling. Mr. Bessemer makes no attempt at correcting either the translatory part of a ship's oscillation, or the pitching. He considers that in large vessels such as he proposes to use, both these motions will be small, and not sufficient to cause sickness when once the rolling motion is got rid of. We think there is very much to bear out his view of the case; but we also think that, considering the difference which always exists between experimental and actual circumstances, and especially when we bear in mind that the plan does not correct the whole of the motion, its absolute and entire success is not by any means to be looked upon as a certainty.

The experiment recently made at Denmark Hill must be regarded rather as showing the efficiency of the hydraulic apparatus for regulating the motion, than the effect of its being so regulated.

In the regular heaving of the sea, after the wind has blown sufficiently long to cause regular waves or swell, each particle of water describes a circle in a vertical plane. At the surface, the diameter of these circles is the whole height of the wave from valley to crest. These circles rapidly diminish in size as their depth below the surface increases. Taking into account this diminution, as well as the effect of a ship's breadth, it is certain that the ship will not follow this circular motion at all to the same extent as a cork floating on the surface. In moderately heavy weather, it is probable that in such a ship as is proposed by Mr. Bessemer, any fixed point could describe a circle of five or six feet in diameter, quite independently of any rotatory (or rocking) motion. It is much to be regretted that the model at Denmark Hill was not mounted on a crank or eccentric, so as to combine this motion with the simple rocking, and to ascertain how far it remained as a cause of real uneasiness, when the rocking had been eliminated.

It is to be observed that a level does not give a fixed direction when a ship is moving upon waves. Apart from any rolling of the ship's own, it gives, when its centre is describing a circle uniformly, not the direction of actual gravity, but the resultant of gravity and of the centrifugal force. In fact, instead of being horizontal with reference to the earth, it is horizontal with reference to the effective wave surface. But as this is also the direction with reference to which a man has to balance himself in sitting or standing, it tells us what is practically, though not actually, the upright, and therefore is probably a better guide than a truly vertical or horizontal line.

It must not be supposed that the feeling of the dec sinking under one, or the motion which produces thi effect, is an actual translatory motion shared by the whole vessel. By far the greater part of it is due to rocking about some centre (whether fixed or instantaneous), at some distance from the passenger, just as a boy moves really up and down on a see-saw, while the plank simply rocks about a fixed centre. A very large portion of the apparent motion of translation will therefore be cured by neutralising the rocking; and so far as rolling is concerned, we have no doubt that all rocking will be effectually cured. Even as regards pitching, we are disposed to think that in large vessels this is seldom very troublesome when there is pitching and nothing else. It is the combination of pitching with rolling which is so difficult to bear; and we have reason to know that a vessel's pitching is almost invariably accompanied with a roll of very considerably greater amount than the fore and aft motion. Apart from the much more confused and distressing character of the combined motion, we think that the pitching would be found to be a much smaller effect than is commonly believed, if the rolling were wholly got rid of.

On the whole, while we are unwilling to commit ourselves to any prophecy, either of complete success or of partial failure, we think very favourably of the proposal. As a mere scientific experiment it is one of the very highest interest. As a practical design it offers a sure prospect of realising a large part of its intention, and a fair prospect of attaining a high degree of success. We feel confident that it will save a great many who would otherwise suffer, from being sea-sick at all, but we can hardly hope that there will not be sufficient residual motion in very heavy weather to cause some degree of uneasiness to very sensitive persons; nor would we venture to predict what will be the numerical reduction in the proportion of persons relieved from sickness, or the amount of alleviation to those not wholly saved from it.

It remains to say a few words on the question of safety. The inquiry of the timid will be, What if anything goes wrong? How will you control this great moving mass of 150 or 200 tons if a valve should give way or a pipe burst? The answer is immediate. In case of accident, the saloon would simply be disabled from moving independently of the ship, and the worst that could happen would be that the passengers would not get the relief desired, but would simply be as in the saloon of an ordinary vessel, and with much better ventilation. Even if the machinery broke down badly, it would be the work of a moment for those in charge to jam the saloon most effectually, so as to make it a fixed part of the ship. The hydraulic machinery is similar to that which has been for a long time used by Mr. Bessemer in controlling large masses of molten iron, and has, therefore, been fully tested and shown to be efficient.

SCIENCE IN CEYLON

A SUPPLEMENT to a recent number of the *Ceylon Observer* contains the first address of the new Governor of Ceylon, his Excellency the Right Hon. W. H. Gregory. On the opening of the session of the Legislative Council, his Excellency proposes to take a vote of 50,000 rupees for the commencement of a Museum of Natural History and Antiquities. The cost of the building when completed in the rough is to be 80,000 rupees. He says, "the want of a museum in which may be represented the natural history, antiquities, and industrial products of the island has been forcibly urged on me by persons of all classes. For a comparatively small sum, considering the object in view, a museum may be constructed, which shall not be a mere random collection of miscellaneous objects, but a scientific teaching exhibition. To carry out thoroughly our purpose, it will be necessary that the head of the institution should be a person competent from knowledge and scientific training to arrange in proper sequence the various specimens as they come in, to give information to the student, and probably to give lectures occasionally on the different branches of the collections, such as on the principles of classification, the habits, instincts, and economical uses of each class." The salary of the Director to be appointed is to be a liberal one, in order that a man of high acquirements may be induced to undertake the task. The archæology of the island is to be well represented in the museum, and to contain reproductions of the many ancient inscriptions therein existing in the form of photographs, casts, and hand copies. The collection generally is to be strictly confined to the products of Ceylon. New regulations are to be made for the management of the forests and to prevent the present waste of timber, for the carrying out of which foresters are to be appointed. A hope is expressed that the cultivation of cinchona will be extended. The soil and climate of Ceylon are peculiarly adapted to the growth of this plant, Ceylon samples of bark fetching a higher market price than similar ones from Ootacamund. It is also hoped that the production of tea may be taken up by the planters. Silk may, perhaps, also be added to the productions of the island. The mulberry tree grows quickly and vigorously in Ceylon, the worms are reported hardy and to thrive well; but difficulties arise from the want of patient and skilled hands in the winding of the silk. The dried cocoons would probably have to be sent to Europe to be spun, as they are at present in largely increasing quantities from various parts of the East. Regulations are to be made for the preservation of game, *i.e.*, deer, elk, buffaloes, and pea-fowls, not for the benefit of the sportsmen, but for that of the native population.

The natives complain that bodies of strangers enter a district, drive into a narrow compass and shoot down and wound large quantities of deer, the flesh of which is dried, carried away, and sold; that this wholesale destruction goes on at all seasons; and that the breed of buffaloes is deteriorating by the slaughter of the wild males. The tame buffaloes are, in Ceylon, turned out loose into the jungle when not employed in the paddy fields or elsewhere, and interbreed with the wild ones. During the whole of the Governor's journeys in the northern and eastern provinces he saw only two deer and heard one pea-fowl, although riding over ground where, a few years previously, all kind of game abounded. We think the Governor was unlucky in his experiences. There are still plenty of peacocks to be seen about Trincomalee, at least where we lately came across upwards of thirty in one afternoon. It is still extremely desirable that the wanton destruction of game should be put a stop to. A close time is to be enforced and driving prohibited except by the inhabitants of a dis rict. Reference is further made to the late floods. Within he last fortnight a great calamity has befallen us. Inunlations to an extent unknown in the colony for a long eries of years have inflicted serious though only temporary lamage on a large tract of country. The loss of life, so ar as I can ascertain, has been but small, considering the uddenness and extent of the floods; but many houses ave been swept away, and a large amount of native property destroyed."

It appears that a bridge on the Randy railway, that over the Hanwella road, was broken down by the flood, and at the time the Governor spoke traffic with the Central Province was interrupted. Three persons employed in the department were drowned when the railway bridge was swept away. Science is evidently not likely to suffer in the hands of Mr. Gregory.

OCEAN METEOROLOGICAL OBSERVATIONS

Remarks to accompany the Monthly Charts of Meteorological Observations for No. 3 *Square, extending from the Equator to* 10° *N., and from* 20° *to* 30° *W.* (Printed for private circulation, by authority of the Meteorological Committee of the Board of Trade.)

THIS portion of the Meteorological Committee's work in the discussion of Ocean Meteorology has been printed by the Committee for distribution among meteorologists and others, with the view of eliciting their opinions on the utility of the method adopted, together with any suggestions they may have to offer. The chart issued with the remarks gives the results of the discussion of No. 3 Square of Marsden's numbered squares for the month of January. This square has been selected as the one of greatest importance, and in which the largest number of observations have been collected. It is divided in the chart into 100 squares of 1° each, in which are set down, in a compact form, the results of the discussion as respects wind, variation, atmospheric pressure, air and sea temperature, humidity, the currents and specific gravity of the sea, and, in the margin, weather and cloud.

In attempting to give the results of so many subjects in a small space, and with one printing, not a little has been sacrificed to clearness. The chart has considerable merit as an ingenious and compact tabulation of results; but little praise can be awarded to it as a chart or diagram telling its own story at once clearly and readily to the eye—a characteristic which charts specially addressed to seamen ought to have. Printing in colours would introduce some improvement, but as regards the important subject of the winds more will be required, if the present method of presenting the results be adhered to. By this method the arrow representing the largest number of wind observations extends to the centre of the circle included in each square; and hence the arrows representing the winds of *different* squares cannot be directly compared together. Since such comparisons can only be made by the arrows of each square being drawn to show by their lengths the percentages each wind direction is of the whole number of winds observed in the square, a separate wind chart will be necessary in the text accompanying the charts.

Three small charts are given with the Remarks (p. 43), showing the pressure and temperature of the air and the temperature of the sea. These have been constructed by grouping the 100 squares into twenty-five squares of 2° each. As respects pressure, the isobarics are drawn for every two-hundredths of an inch of mean pressure. The *outré* forms of the isobarics are such as to suggest the idea that the method of discussing the barometric observations is faulty. An examination shows it to be so on two important points, which will appear from the following extract from the chart of the observations of the four contiguous sub-squares (Nos. 59, 58, 49, and 48), of which the mean pressures are stated in inches, the number of observations in each case being printed within brackets:—

6° N.		
	29·882	29.963
	(3)	(14)
5° N.		
	29·870	29·939
	(2)	(15)
4° N.		

30° W. 29° W. 28° W.

In the small isobaric chart these four results are treated as of equal value, and the average of this 2° square is calculated by taking their simple arithmetical mean; accordingly 29·914 inches is entered as the mean. Now a little reflection shows that the averages 29·882 and 29·870 inches, based respectively on 3 and 2 observations, are very faulty as approximations to the true averages of their squares. In such cases the method of discussion is to deduce the new averages not from the averages of the four sub-squares, but from the whole of the observations added together and divided by 34, the number of the observations. By doing so we obtain in the above case the average 29·940 inches. Similarly we have discussed the whole of the 100 squares, and the result is the disappearance of several of the anomalies in the new isobarics drawn from the twenty-five new averages thus calculated.

But other anomalies remain, which lead to the second point on which the method of discussion is defective. The method is thus described in the Introductory Remarks (page 1):—

> "The various hours at which the observations were taken may not give the mean result for the twenty-four hours; still, as the same hours have been generally extracted, we may confidently hope that the temperatures and pressures obtained from the means of the whole will give very good relative results for comparing the meteorological state of one part of 10° square with that of another. In making the extracts the hour of each observation has been recorded, so that any inquiry depending on the hours might be carried out if thought requisite."

The confident hope here expressed is very remarkable in the face of the averages printed on the chart, of which an example is given above. The truth is, comparableness of the results of the different squares is not to be looked for except in cases where the observations are numerous. Since the daily range of the barometer is large in these regions, averages based only on a few observations—regarding the hours at which they were made we have no information—are worthless in every inquiry in which comparisons require to be made. Now looking at the squares, we find from the chart that there are fifty-one out of the 100 whose pressure averages are based on fewer than twenty observations; thirty-five averages on fewer than fifteen observations; and sixteen averages, or a sixth of the whole, based on fewer than ten observations. Hence the incomparableness of the results of the 1° and 2° squares, *inter se*, and the general unsatisfactoriness of this part of the work. The same objections apply with perhaps equal force to the discussions of the temperatures of the air and those of the sea.

Range corrections for pressure and temperature over the region under discussion are not yet accurately enough known to justify the committee in "correcting" the results on the large chart by hypothetical corrections. Since, however, it is most desirable to attempt a discussion of the results of the squares, so as to arrive at a knowledge of the approximate distribution of the temperature and pressure of this important part of the ocean; and since such a discussion necessarily calls for a preliminary preparation of the results by the application of such approximate corrections for range as we are in possession of, and which cannot be far from the mark; the Meteorological Committee will require to give *the mean day of the month and the mean hour of the day for each of the averages of the squares.* Indeed, without this additional information the results can scarcely be said to possess any strict scientific value.

With this additional information, some highly interesting questions suggested by the chart could be examined, such as the relations of the pressure, air and sea temperature, and humidity in these 1° squares, viz., Nos. 93, 94; 82, 83; and 72, 73, to the squares contiguous to them. But, so far as the chart informs us, the interesting anomalies here indicated may be due to no more than differences in the mean hour of the observations of each square.

We should also wish to see added, as respects each square, an enumeration of all the unusually low and unusually high observations of pressure and temperature which have been made use of in calculating the averages. This will be the more desirable as the discussion proceeds into other parts of the ocean where barometric and thermometric disturbances are of more frequent occurrence, and where the number of observations is fewer than in this No. 3 square "in which the largest number of observations have been collected."

The vital importance of a knowledge of pressure and temperature range in discussing Ocean Meteorology it is unnecessary to insist upon. For this information we must look, perhaps we may say exclusively, to the Boards of Admiralty of this and other countries, it being only through such bodies that systems of hourly or two-hourly observations at sea can be organised and carried out. May we hope that, among the contributions to science which Prof. Wyville Thomson will bring back from his circumnavigation cruise, one will be data for the determination of barometric and thermometric constants which are so indispensable in the reduction of Ocean Meteorological statistics.

In offering these suggestions to the consideration of the Meteorological Committee, we desire to express our deep sense of the importance of this department of their work, and our hearty thanks for the care they are taking to ensure its efficient execution; and we may confidently hope that the method of discussion finally resolved on will lead to results which, taken in connection with similar d sions undertaken by the Dutch, French, German, wegian, and other Governments, will place Ocean Me ology on a broad and sound basis, and thus lead tow the solution of many questions vital, not merely to gation, but to a right understanding of the more com problems of the Land Meteorology of the Globe.

GIEBEL'S THESAURUS ORNITHOLO

Thesaurus Ornithologiæ. Repertorium der gesam ornithologischen Literatur und Nomenclatur sam licher Gattungen und Arten der Vögel nebst Synon und geographischer Verbreitung. Von Dr. C. Giebel. Erster und Zweiter Halbbänder. (Leip Brockhaus, 1872.)

IN this work, we regret to say, the *performance* not equal the promise. Nothing would be more ceptable to the many students of the class *of Birds* such a "Repertorium" as Prof. Giebel's title seems indicate. Nor is there anything objectionable in manner in which he proposes to treat his what extensive subject, although other plans would equally or more convenient. But when we come to into details and to consider the mode of execution, must condemn the work as almost useless *to ornitho-*gists from its errors and imperfections.

The first portion of the "Repertorium" *professes* give us a complete list of the literature relating to thology, arranged under certain heads. But numerous volumes and papers of the greatest *importance* to ornithologist are either altogether omitted, or are inser-ed under wrong headings. For example, *Cabanis* Heine's "Museum Heineanum" is not alluded to at nor can we find Finsch and Hartlaub's "*Ornitholog* Ost-Afrika's," Fraser's "Zoologia Typica," or Gilliss's "Astronomical Expedition" (Birds by Cassin) entered under the proper heads. These are all works which working ornithologist would have occasion to consult fre-quently. A long list might easily be made *of similar* omissions. In the section of this part of the "Repertorium" which treats of local faunas, many *ridiculous* blunders are made. Memoirs referring to Africa an South America are entered under Asia, and a number of South American papers are attributed either to *Ameri Septentrionalis*, or *America Centralis*.

In the second part of the "Repertorium," *called* "Nomenclator Ornithologicus," it is pretended to give a list of all the described genera and species of the class of birds in alphabetical order, with references to authorities, synonymy, and other points. Nothing could be of greater use to the ornithologist, if such a task were *well* or even fairly well performed. But this, we regret to say, is not the case, as anyone with previous knowledge of the subject will very quickly discover, on turning over Prof. Giebel's pages. It is, in fact, quite evident that the "Repertorium" is a mere compilation, upon which, no doubt, long and weary labour has been bestowed, but which, as is often the case with compilations, *will be of* very little value to the student, owing to the compiler having had insufficient previous knowledge of his subject.

OUR BOOK SHELF

Palæontographica. Beiträge zur Naturgeschichte der Vorwelt, herausgegeben von Dr. W. Dunker and Dr. K. A. Zittel. Band XX. Lief. 5. September 1872. (London: Williams and Norgate.)

THIS part of the "Palæontographica" contains a continuation of Dr. Geinitz's description of the fossils of the Lower Quader Sandstone of the Valley of the Elbe in Saxony, and includes an account of the Brachiopoda and the early families (Hippuritidæ, Ostracidæ, Spondylidæ, and Pectinidæ) of the Pelecypoda. The species are carefully described and beautifully figured, and the synonymy and distribution of them are discussed at some length, so that the work must be regarded as indispensable for the student of the Cretaceous rocks.

In some general remarks prefixed to his descriptions Dr. Geinitz calls attention to the interest attaching to these Saxon fossils, in some cases owing to their wide geographical range, in others to their long range in time during the Cretaceous period. Thus of the species here noticed, *Ostrea carinata, diluviana*, and *hippopodium, Exogyra lateralis, columba*, and *haliotoidea, Pecten membranaceus*, and *curvatus, Vola phaseola, quinquecostata*, and *quadricostata*, and *Lima tecta*, are common to the Cretaceous rocks of the Elbe Valley in Saxony and of Southern India, in both which localities the lower members of the Cretaceous series (Neocomian and Gault) are wanting. *Inoceramus labiatus* and *Ammonites peramplus* are also referred to as fossils common to the two localities. On the other hand a collection of Cretaceous fossils from the neighbourhood of Colorado city and the north of New Mexico also included examples of *Inoceramus labiatus, Ammonites peramplus, Baculites baculoides, Inoceramus Brongniarti*, and a species resembling *I. striatus*, evidently representing the Middle Planer of the Elbe Valley, and derived from similar beds of Chalk-marl, over which lie beds with *Inoc. Goldfussianus*, Baculites, and Scaphites, evidently belonging to the age of the White Chalk. These facts, as Dr. Geinitz remarks, furnish support to the assumption of migrations of species from India to Europe, or from Europe to America, long before the human race took the same road.

The most interesting cases of the long-continued existence of species are those relating to the occurrence thus low down in the Cretaceous series of species common to these deposits and to the latest beds of this formation in the province of Schonen in Sweden. Dr. Geinitz also calls attention to the variations occurring in the species here noticed, and to the apparent interdependence of many of those in older and newer parts of the formation, so that, as he says, "it is not difficult to sketch a regular genealogical tree for various series."

Theoretische Maschinenlehre. Von Dr. F. Grashof. In vier Banden. Erster Band. Erste Lieferung. (London: Williams and Norgate.)

THE first number of this work has been issued during the present year. From the preface we learn that the object of the work is the theoretical investigation of the problems involved in the theory of machinery. In the first volume will be discussed the mechanical theory of heat, the theory of hydraulics, and certain other parts of theoretical physics and of applied mechanics, which will be useful in the subsequent portions. The second volume will contain the elements of machines, of mechanical movements, and of governors, and also of mechanical instruments—*i.e.*, instruments for measuring time, velocity, mass, force, and energy.

The third volume discusses the machines which serve for the application of natural agents to technical purposes, machines for employing the power of animals, hydraulic wheels, windmills, steam engines, and especially heat engines in the widest sense. Finally, the fourth volume will be occupied with machines for doing work (*Arbeitmaschinen*)—that is, machines for moving about and hoisting solid, liquid, and gaseous bodies (locomotives, screw-propellers, winding machines, rams, pumps, blowing machines), also machines for the working and manipulation of rigid bodies, such as hammering and rolling machines, sawing machines, &c.

The number which lies before us principally discusses the mechanical theory of heat. This subject is entered into with great thoroughness and profundity, and includes an elaborate discussion upon radiant heat and many other collateral matters. It need hardly be added that for the perusal of this work a sound knowledge of mathematics is indispensable.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Kew Gardens and the National Herbarium

PROF. OWEN has very imperfectly stated the facts respecting the cultivation of the ipecacuanha plant at Kew and in India.

My friend Mr. McNab says of the ipecacuanha (Trans. Bot. Soc., vol. x. 319): "It is a plant of remarkably slow growth; the largest plant in the Botanic Garden at Edinburgh is scarcely one foot in height, although more than thirty years of age, and has three leading shoots, each four inches in length. The method hitherto adopted of propagating the *Cephaëlis* (as far as I am aware) is by cuttings, but of these not more than one or two can be got at a time, and at long intervals."

It was the possession in the Edinburgh Botanic Garden of old long-established plants, with well-developed, rhizome-like rootlets, and the difficulty experienced there in obtaining cuttings, which suggested to Mr. McNab a method of propagation which has since been found exceedingly successful, and for which he deserves every possible credit. In a printed report to the Secretary of State for India (11695) Dr. Anderson states: "It was when examining the old plants in order that the best method of propagating might be determined on, that it occurred to Mr. McNab that the numerous root-like tubers might be taken advantage of as a means of rapidly increasing the plant."

At Kew no such great difficulty has been experienced in increasing the ipecacuanha by ordinary cuttings, the original specimen having during the last six years been by this means increased manifold. On the other hand, the constant demand for cuttings from the Kew plant has prevented the formation of the tuberous rhizomes which in the case of the Edinburgh one were the result of thirty years' growth.

As far as the resources of Kew Gardens would allow, all three presidencies of India were supplied with ipecacuanha plants, not once only, but at various times. Most of these perished in India, some from being planted in unsuitable sites, others from accident; and it was not till 1868 that its cultivation promised success, upon which its propagation on an extensive scale was ordered by the Government of India.

Of the plants sent to Calcutta from Kew, one which arrived in 1866 had in 1869 produced twenty plants (Anderson, l.c. p. 3); of these twelve were sent to Sikkim, where seven were "killed by a coolie falling on them and completely smashing them" (Report of the Calcutta Botanic Garden, April 25, 1871). The further history of the remainder is detailed in Dr. King's report, which is quoted by Prof. Owen, but in a very unfair manner. The passage which he has extracted proceeds as follows beyond the point where he stops: "The five plants in Sikkim were, early in the current year, submitted by Messrs. Gammie, Bierman, and Jaffrey, of the Cinchona plantations, to a most successful experiment in artificial propagation, by which four hundred cuttings were obtained, the greater proportion of which have formed good roots, and are now fine healthy little plants."

That the cultivation of ipecacuanha should be taken up at Edinburgh is nothing more than might reasonably be demanded of a garden maintained at the national expense. It was indeed an arrangement which the residence at Edinburgh of Dr. Anderson, the then Superintendent of the Calcutta Botanic Garden, who was home on sick leave, rendered eminently desirable, and one upon which I was fully consulted by the Government, as appears in Dr. Anderson's report already quoted. Nor, in reference to the subject, should it in fairness be suppressed, that not only has the successful introduction of the ipecacuanha into India been due to the establishment at Kew, but that Kew has at the same time supplied living plants to Ceylon, the Mauritius, Jamaica, Trinidad, Barbadoes, Queensland, and various home and continental gardens.

Prof. Owen again appears to have been completely misinformed in respect to *Welwitschia*, which, he implies, had been sent to Kew in a state fit for cultivation. A very large and old specimen with the tap-root chopped off before its arrival, was placed for convenience in a pot of earth, and exhibited in the succulent house, where it would be likely to attract much attention, and would also be in contiguity to other plants from the same region. This was done without the slightest expectation of its showing any disposition to grow, and solely to gratify the public curiosity. On the appearance of symptoms of decay from the dampness incidental to a greenhouse, it was at once transferred to the museum, where it now remains. Prof. Owen, apparently quoting a statement in my memoir on *Welwitschia*, pointedly alludes to the fact that "cones with ripe seeds" had been received at Kew, but he omits to give the following words, "the albumen of which was perfectly rotten;" and when alluding to my acknowledgment of the receipt of "fine young plants," he does not add that these were Dr. Welwitsch's specimens gathered years before.

Prof. Owen refers to my answer to Q. 6,661 in the evidence given before the Royal Commission, as having by groundless insinuation "inflicted pain on fellow-servants of the State and collaborators in science, on men at least his (my) equals, and one of whom in a recondite botanical problem has shown himself his (my) superior." As Prof. Owen does not quote this question and answer, I shall do so. They are as follows:—*Q.* 6,661.—"Has there been insufficient space in the British Museum for the reception of specimens for the enlargement of its herbaria, or has any other obstacle interfered?"—*A.* "With regard to the British Museum I do not think any person can answer that except the officers of the establishment. I do not think that the nature and extent of its botanical collections or their condition is well known except to its officers."

I leave it to the reader to say whether any possible insinuation could be conveyed in such an answer, and, being unconscious of any, shall conclude with expressing my conviction that here again Prof. Owen has been misinformed. J. D. HOOKER

Royal Gardens, Kew, Nov. 15

The Diathermacy of Flame

I HAVE to thank Lord Rosse for pointing out an omission in my communication on this subject. It was not, however, an "oversight," as Lord Rosse supposes, the source of error in question having been duly considered, and its amount calculated, when the experiments were made. It was neglected on account of its smallness. As its theoretical importance is unquestionable, and the amount of experimental error is likely to be much overrated, I gladly supply the following figures, which show that this source of error was fairly negligible.

As heat, like all other radiant forces, necessarily diffuses with the square of the distance from its source, my method of maintaining a constant mean distance by lighting an equal number of jets equidistant from each side of the middle flame, was liable to an error equal to the difference between the square of the distance of the middle flame from the thermometer and the mean of the squares of the distances of the other flames. The flames were ¼ of an inch apart, and the middle flame was 14 in. distant from the thermometer. Thus, in the first trial, when only three flames were lighted, the distance of the nearest was 13¾ in., of the middle 14 in., and of the farthest 14¼ in. Taking ¼ in. as our unit, the middle flame was 56 distant, the nearest 55, and the farthest 57. $56^2 = 3136$, $55^2 = 3025$, and $57^2 = 3249$. The mean of 3025 and 3249 is 3137, instead of 3136 as experimentally assumed; the error in this case is thus only $\frac{1}{3137}$ of the 4° increase which my thermometer registered, or $\frac{1}{784 \cdot 25}$ of a degree, a quantity far too small for consideration in using a common laboratory thermometer reading only to half degrees.

Proceeding onwards, the error of course continued increasing until it reached its maximum, when the 1st and 17th jet were lighted. The 1st was 48 quarter inches distant from the thermometer, the 17th was 62. $48^2 = 2304$, $62^2 = 3844$. The mean of these is 3074, instead of the experimentally assumed mean of $56^2 = 3136$. The difference is 62, *i.e.* $\frac{1}{50 \cdot 3}$ of 5°—the last increment of heat. Thus the *maximum* error was less than $\frac{1}{10}$ of a degreee, and the mean error lies between this and $\frac{1}{784 \cdot 25}$ of a degree.

As regards the last paragraph of Lord Rosse's letter, I would suggest that, with gas passing through a given orifice, the passage of equal quantities neccessarily implies equal pressure; that in turning the micrometer screw of the supply tap so as to cause each additional pair of equal jets to consume an equal additional quantity of gas, I was merely admitting into the space between the tap and the jets a quantity of gas just sufficient to maintain an equal elastic tension or pressure in spite of the varying quantity issuing from the jets.

W. MATTIEU WILLIAMS

Skeletons of Wild Animals

MR. CLARK, of Cambridge, in NATURE of Oct. 31, remarks on the general absence of skeletons, especially those of the Felidæ, in museums, and states that, so far as he knows, no European museum possesses more than skulls. It is with pleasure, therefore, that I draw his attention to the fact of the existence of a perfect skeleton of the lion in the Ipswich Museum. Besides this, there is a skeleton of the mole, one of the dog-faced monkey (*Cynocephalus anubis*), one of the dolphin, two very finely prepared skeletons of the boa constrictor, besides others of the ostrich, &c. J. E. TAYLOR

Treble Rainbow

ABOUT the middle of August, whilst standing on platform of the station at Exmouth, I witnessed a phenomenon which I think is rare enough to be worthy of record. The sun was about an hour off the western horizon, and the river, which is to the west of the station, and is in that part about a mile and a-half broad, was perfectly calm; but there must have been a breeze blowing overhead, for a heavy shower of rain came rapidly up from the westward, and when it had passed to leeward displayed the two ordinary rainbows brightly; and not only these, but between them appeared the arcs of a third bow cutting the other two, the inner one on the horizon and the outer about ten degrees or thereabouts above it. This third rainbow appeared to have its centre as much above as that of the ordinary rainbow was below the horizon, and was due to the reflection of the sun from the calm surface of the river. The arcs of the third rainbow extended but a very small distance beyond the secondary bow, but were bright enough at the intersection to show a sort of checkwork of colours, which presented a most curious appearance.

Oxford, Nov. 5 A. MALLOCK

Circular Spraybows

THERE have been several accounts lately in NATURE of circular rainbows, but none of your correspondents have mentioned "circular spraybows;" of course, in themselves they are of no great value, but under certain circumstances they can be seen so near that their brilliancy exceeds that of a rainbow.

The most perfect which I have seen was at the Falls of Foyers off Loch-ness, at 8 A.M. on September 1, 1868. The previous day had been wet, so that the falls had a greater volume of water than usual. At that time the sun, as seen from the platform for viewing the falls, was ascending just above the ledge of the rock over which the water was precipitated, and on looking away from it an entire rainbow was visible, excepting that part which was caused by the shadow of the lower part of my body; in consequence of the spray being all round me, the proximity of the bow added brilliancy to the colours, which surpassed anything of the kind that could be seen in a rainbow. I took no measurements.

Can any of your correspondents give examples of bows being seen on a cloudless background? Some years ago I saw a rainbow in what seemed a cloudless sky, but the surprising fact that rain was lightly falling from this apparently cloudless sky shows that if there were not clouds there were drops of water-fall over a large area, and which formed a background. I am aware of Mr. Browning's authority for such a phenomenon.

Birkenhead G. H. H.

Elephas Americanus in Canada

CAPTAIN HOWDEN, of Millbrook, Ontario, has lately discovered remains of this species in a field adjoining his residence. They were found in the humus quite near the surface, and with the exception of the molars have been very much broken by the plough. The locality is a deep basin, depressed 100 or 150 feet below the surrounding hills, which may have been the basin of a small lake or pond. The elevation is about 490 feet above Lake Ontario, and 125 feet above Rice Lake, on the northern slope of the drift-ridge which borders Lake Ontario on the north. The discovery is interesting as extending the range of this animal in Canada, eastward, along this drift-ridge. The remains heretofore discovered have been confined to the western peninsula, above the Silurian escarpment, or to positions so nearly adjacent that they may have been washed down from this upper region. The present discovery is at an elevation which precludes this, and seems to indicate the presence of the living animal in this region. Between the ridge and the present lake shore there are at least two ancient lake beaches, one about 100 feet above the present water level, the other a little over 200 feet. Neither of these would bring the waters of the lake up to the level of the escarpment; so that at the time of these higher lake levels, the elephant may have ranged over the western peninsula of Canada, and also eastward over the drift-hills which extend nearly to the lower end of Lake Ontario.

Victoria College, Cobourg, Oct. 4 N. BURWASH

Reason or Instinct?

CONSIDERATIONS on the nature of Instinct will ever engage the attention of the student of Nature, and certainly interest in the subject is not likely to flag at a time when psychological manifestations and relations are being more and more sought amongst the lower animals. Your correspondent of the 10th of October last touches on their power of enumeration, which, even in the case of the sagacious dog, appears to be very limited. Nevertheless, I have been assured by a reliable friend, now deceased, that his wiry terrier would, at his order, run round the table once, twice, or thrice, for a suitable reward.

The idea of alternation, and an example of memory, came under my own observation some time ago at the Grotto del Cani, near Naples, where I witnessed the somewhat unnecessary experiment of the deleterious effects of carbonic acid on the unfortunate dogs kept for that purpose. On walking to the cave, I remarked that one of the dogs gambolled round the guide, whilst the other followed at his heels with slouched tail and hanging ear. The guide assured me that each dog knew when it was his turn to be dropped into the heavy stratum of gas on the floor of the cave, from whence, after partial suffocation, he is thrown into the cool lake close by for resuscitation.

With reference to the *quasi*-reasoning in adaptation of means to an end, under exceptional circumstances, I adduce the following:—

Many caterpillars of *Pieris rapæ* have, during this autumn, fed below my windows. On searching for suitable positions for passing into chrysalides, some eight or ten individuals, in their direct march upwards, encountered the plate-glass panes of my windows; on these they appeared to be unable to stand. Accordingly, in every case they made silken ladders, some of them five feet long, each ladder being formed of a single continuous thread, woven in elegant loops from side to side. The method here adopted is similar in kind to that employed by the glacier climber, who cuts foot-holes with his hatchet to enable him to mount the icy precipices which impede him.

In the case of the above caterpillars, however, reasoning seems to be but narrow, for one ladder was constructed parallel to the window-frame for nearly three feet, on which secure footing could be had by simply diverting the track two inches. Some of these insects have now passed into pupæ, and are curiously supported or slung by their well-known silken band across the thorax, under the drip-stone of the window. Such facts, though simple, should warn us against dogmatically fixing the points in the animal kingdom at which instinct ends and reason begins. Do they not overlap? G. B. BUCKTON

Weycombe, Haslemere

Lunar Calendars

IN a communication addressed to NATURE for 1871, Mr. S. M. Drach writes at p. 204. "The true mean conjunction derived from the 19-year cycle is called the Molad or Moon-birth," and I wish to ascertain how this so-called "mean conjunction" is arrived at.

I have before me the two new Almanacks published by Vallentine and by Abrahams, by which I find the "moon-birth" generally put down at about six hours after the time quoted in the "Nautical Almanack" for 1873. From facts that have reached me, I conclude that the data for these publications are derived from a skeleton almanack printed by German Jews at Altona, containing the necessary particulars for fifty and eighty years in advance; and no doubt correctly calculated for that locality. I ask whether the data there given are to be accepted by Jews in all countries, or whether they are at liberty to calculate the time of new moon for their own meridian?

I may take this opportunity to point out the following discrepancy:—

True New Moon, Thursday, Nov. 20, 1873, 3.36 A.M.
Moeled Kislev, Wednesday, Nov. 19, 1873, 1.14. I A.M.,

according to Vallentine, but marked P.M. in Abrahams. Both the latter must be in error, because in *advance* of true time.

MYOPS

Early Eclipses

IN looking through some back numbers of NATURE, I came on a paper by Mr. Hind, in which he examines whether any great eclipse took place at the time of the Crucifixion of Christ. He says that "although a great total eclipse was visible at Jerusalem in A.D. 29, yet, in the year 33 no eclipse of importance took place." * Mr. Hind seems to have forgotten that in the opinion of most divines, Christ was born four years before the vulgar era, so that in the year 29 He would have been 33 years old. Remembering this point, it seems highly probable that the account of how "the sun was turned into darkness, and the moon into blood" may be a correct account, not only of the occurrence of an eclipse, but of an early observation of the now famous red prominences. G.

Cambridge

Water-beetles

I HAVE to thank Mr. Buchanan White (NATURE, Sept. 12) for the statement that "many water-beetles are not only winged but use their wings." My error as to fact, however, has no effect on the argument of my letter (NATURE, Sept. 5), which was, that although it is probable the first insects emerged from the water with their wings formed, yet the existing aquatic insects throw no light on the origin of the class.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, County Antrim

PHOSPHORESCENCE IN FISH

IN two recent numbers of NATURE, Nos. 153 and 154, and more particularly the former one, attention is drawn to the question of phosphoric phenomena connected with living fish; but while it has been proved beyond dispute that certain fish, *Cyclopterus lumpus*, for instance, do possess highly luminous properties, the two cases in point may, I think, be referred rather to the combined effects of the microscopic *Noctilucæ*.

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* I quote from memory, and therefore perhaps not quite in Mr. Hind's words.

During my last dredging cruise off the coast of Portugal, I enjoyed many opportunities of witnessing the brilliant and varied aspects under which such phosphorescence exhibits itself, though instances more strictly parallel with those quoted in the two communications referred to, occurred, perhaps, while returning by steamer from Lisbon, after its expiration.

On such favourable nights, as the vessel progressed through the waters, shoals of small fish might be seen darting away in every direction, themselves apparently luminous, and leaving behind them bright tracks of phosphoric light, while now and then a fish of larger size would make its appearance, producing a similar effect, though of proportionately greater brilliancy. The *coup d'œil* produced by their countless numbers was most magnificent, and in miniature vividly recalled to mind the meteoric showers that periodically illumine our summer nights. On all such occasions as the foregoing, the water when closely examined was invariably found to be literally teeming with *Noctiluca miliaris*, its presence being manifest again in the broad track of phosphoric light visible for many hundred yards in the wake of the vessel, while the shaft of the screw was brilliantly illuminated by their countless numbers, excited into active display of their phosphoric properties by the rapid revolutions of its ponderous blades.

Had Mr. Hall examined the "globules of fatty matter" contained in the spray thrown on deck on the night he refers to, with the aid of the microscope, he would no doubt have traced the light to the same source, and discovered that each luminous point represented a single individual of the tiny rhizopod here mentioned. His hypothesis that they were possibly portions of "fatty matter" thrown off by the fish themselves, seems scarcely tenable, and more particularly if we accept, as we are bound to, that the luminous tracks left behind as the fish swims onwards are attributable to a like origin, and which immediately suggests that such rapid desiccation would exercise as ruinous an effect upon the poor animals' organisation as befell the celebrated racing pigeon of American notoriety, reported to have arrived at its destination bereft of every feather, lost one by one through the friction attendant upon the high rate of speed at which the bird had travelled.

In addition to *Noctiluca*, innumerable other forms, such as minute Crustacea, Salpæ, jelly-fish, &c., contribute towards the ocean's nocturnal luminosity; but all these latter, and more especially the Salpæ, for the most part display their light spontaneously, and are restricted to local and comparatively small areas of the ocean's surface; while in *Noctiluca* that luminosity is entirely latent, being dependent upon natural or artificial disturbance and excitement to bring it into action; and though exceedingly minute, the separate individuals rarely measuring the hundredth part of an inch in diameter, occur in such abundance that the whole surface of the sea is equally luminous when disturbed, being frequently so plentiful off our coasts that their aggregated bodies form a superficial crust of considerable thickness. Disturbance of the water at such times is immediately responded to by sheet-like flashes of luminosity, while any object passing through the water appears to be aglow itself, partly from the direct light, and partly from the reflected light produced by these microscopic protozoa. On the same principle the apparent luminosity of living fish is easily explained. Swimming through the water they necessarily disturb countless numbers of these living organisms, whose emitted light, actively scintillating for several seconds after the fish has passed, produces luminous tracks wherever the fish may travel, while its own silvery scales borrow and throw back the earliest coruscations it awakens in its onward course.

W. SAVILLE KENT.

THE FLORA OF THE QUANTOCKS[*]

THE geological formation and the historical associations of the Quantock Hills have been abundantly investigated. Their natural productions, animal or vegetable, have not yet, so far as I know, been described or catalogued, although they contain specimens in both branches of Natural History singularly rare and sought after, and though more than one zoologist or botanist of note gazes on them daily from the windows of his home. A paper whose conditions are that it should be light and popular, and that it should not exceed ten minutes in the delivery, cannot throw much scientific light upon the plants of the most limited region; but it may reveal sources of enjoyment and raise individual enthusiasm, and it may remind this meeting that the time has possibly come, when our association should use the means at its command to encourage the gradual creation of such a flora and fauna of the county as no single naturalist, unassisted by a public body, can in any case trustworthily compile.

In this beautiful valley, fat with the rich red soil that countless millennia have seen washed down from the surrounding hills, the flora is everywhere so unusually rich as to win the envy and delight of strangers. It has been my lot to pilot botanists from all parts of England in search of local rarities; and I have found their chief raptures given not to the uncommon flower they had come to see, but to the profusion of form and colour which includes almost every English genus; manifest in the common turnpike roads which skirt the hills, but revealed in full perfection to those only who penetrate the interior of the range. In the sheltered lanes of the less wooded combes; in the road from Kilve to Parson's farm, the foot path from the Castle of Comfort to Over Stowey, above all in the lane from the Bell inn to Aisholt, the hedge banks and the wide grass margins of the road are scarcely surpassed in beauty by the mosaic of a Swiss meadow or an Alpine slope. From the beginning to the end of June the colours are blue and yellow; the blue represented by the ground ivy, the germander speedwell, the brooklime, the late bugle and the early self-heal, the narrow-leaved flax, the long spikes of milkwort, and the varieties of the violet; the yellow by the birdsfoot trefoil large and small, the St. John's-wort, golden mugweed, and hop trefoil, the agrimony, the yellow vetchling, and the countless kinds of hawkweed. In the hedges above are the mealtree and guelder rose, the madder, white campion and lady's bedstraw, half hidden by the twining tendrils, white blossoms, and tiny cucumbers of the bryony; while here and there where the hedge gives way to an old stone pit or deserted quarry, the tall foxglove and the great yellow mullein stand up, harmonious sisters, to fill the gap. By the middle of July the colours shift. The flora of early spring is gone the milkwort shows its pods, the speedwell its bushy leaves; the yellow still remains; but the blue has given way to pink; to the lovely musk mallow, the horehound, doves foot cranesbill, restharrow, painted cup, and calamint. With August a third change arrives; the small short clustering flowers are gone: instead of them we have the coarse straggling fleabanes, ragworts, and woodsage: th great blue trusses of the tufted vetch and the pure whi trumpets of the bindweed take possession of the hedge the yellow sagittate leaves of the black bryony and the r berries of the mountain ash warn us that summer is pa Our September visit marks the closing scene. The flowe are few and far between; but the ivy bloom is music with bees, the hazels put forth clusters ruddy brown those with which the satyr wooed the Faithful Shepherde the arum pushes its poisonous scarlet fruit between t mats of dying grass; and the meadows which slope wards from the brooks are blue with the flowers of t colchicum.

These are all common flowers, whose names and hab if education did her work, we should learn in childhood from our mother and our nurse: it is their immense profusion, not their rarity, that calls for notice; and they represent but a small part of the hill flora. To exhaust this fairly we must visit four different regions—the hill tops, the bogs, the coppices, and the slopes toward the sea. Of the first it is difficult to speak without a rapturous digression as their familiar sights and sounds occur to us—the breeze that seems half conscious of the joy it brings, the musical hum of bees, the warble of invisible larks, the popping of the dry furze pods in the stillness, the quivering air above the heather, the startled spiders with their appended egg-bags, the grasshoppers, the green hair streaks, the gem-like tigerbeetles on the wing, in the distance the Mendips and the yellow sea, or the long rich valley, closed by Dunkery and Minehead.

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[*] Read before the Somerset Archæological and Natural History S September 12, 1872.

Heath, furze, bracken, and whortle berries, are the four tetrarchs of the hill tops, giving endless shades of red, and green, and yellow. The heaths are three, and only three—the heather, the cross-leaved heath, and the bottle heath, the last exhibiting rarely a white variety, which in the language of flowers tells the tenderest of tales. From beneath their shelter peep the eyebright, the spring potentil, the heath bedstraw, and the creeping St. John's-wort; amidst them springs the uncommon bristly bent grass; everywhere the green paths which wind amongst them are carpeted with the mœnchia and the little breakstone, and bordered by the red and yellow sheep's sorrel and the pale yellow mouse-ear. On many of the prickly furze beds grows the wiry leafless dodder; every ditch is filled with masses of lemon-scented oreopteris, and every patch of stones is hidden by the pink blossoms of the mountain stone crop. At 800 feet above the sea we meet with mat grass and the cross-leaved heath. Higher still we find the slender deers' hair, first cousin to the isolepis of our greenhouses; and highest of all grow, for those who know their haunt, two species of the stag's horn club moss.

The bogs are very numerous. They form the summits of the combes; and some of them descend the hill until they join a deep cut stream. All are covered with the turquoise bloom of the forget-me-not and the glossy peltate leaves of the marsh pennywort, and choked with the little water blinks. They all include liverwort with its umbrella-shaped fructification, sphagnum, marshwort, and pearlwort; and on their margins grow the ivy-leaved hair bell, the lesser spearwort, the lousewort, and the bog pimpernel. In a few of them are found the oblong pondweed and the marsh St. John's-wort; in two combes only, as far as I know, grows, alone of its genus, the round-leaved sundew.

Of the coppices Cockercombe and Seven Wells are the best known; but their large trees check the growth of flowers; and the botanist will find more to please to him in Butterfly Combe and Holford Glen, which are smaller and less frequented. Here in early spring masses of the white wild hyacinth rise amid last year's dead leaves; here grow the cowwheat, woodrush, golden rod, sheeps' scabious, wood pimpernel, wild raspberry, sanicle, and twayblade. The helleborine is found in Crowcombe; in Tetton woods the rare pink lily of the valley; in Cothelstone the adders' tongue and mountain speedwell; in Ashleigh Combe, thelypteris; in Aisholt wood the white foxglove, white herb Robert, and white prunella; while under the famous hollies of Alfoxden, sacred to the memory of "Peter Bell" and "We are Seven," grow the graceful millet grass and a rare variety of the bramble.

On the St. Audries slope the changed soil and the influence of the sea give birth to several new plants. The autumn gentian, the tufted centaury, the round-headed garlic, and the sea starwort are abundant near the cliffs; the perfoliate yellow wort is common; fluellen grows in the stubbles, the lady's tresses near the lime-kiln, the sea pimpernell between the stones, the arrow-grass and hard-grass just above the sea, to which we descend between banks covered, as no other banks are covered, by the magnificent large flowered tutsan.

A few rare plants remain, which come under neither of the groups described. The Cornish money-wort abounds in a small nameless combe near Quantockshead; the rare white stonecrop is indigenous or naturalised at Over Stowey; the white climbing corydalis is found close to Mr. Esdaile's lodge; the lady's mantle, goldilocks, and bistort grow in the Aisholt meadows; the stinking groundsel hard by the remains of Coleridge's holly-bower. In the same neighbourhood I have twice found the purple broomrape; and Wilson's filmy-fern, one of the rarest of British ferns, is established in the Poet's Glen.

I venture to hope that there is no one present to whom this catalogue of plants is a catalogue and nothing more. Our English wildflowers are so charming in themselves, they awake in all of us so many associations, they hold so large a place in our poetical literature, their popular names reveal so many an etymological secret and recall so many a striking superstition, that almost every one, whatever be the line of his mental culture, is willing to own their interest and to linger over their recital. To the Shakspearian scholar they bring memories of Perdita at the shearing-feast, of Ophelia in her madness, of Imogen sung to her untimely grave, of the grey discrowned head of Lear, with its chaplet of "rank fumiters and furrow-weeds." The lover of Milton points to the "rathe primrose," the eye-purging euphrasy, and the amaranth, which was twined in the crowns of worshipping archangels. The historian of the long-buried past sees in the Cornish money-wort, the filmy-fern, and the Lusitanian butterwort of our hills evidence distinct and graphic of the time when Scotland, Ireland, and Spain formed with our own peninsula portions of a single continent. The student of folk-lore tells his tales of the ceremonies which surrounded the vervain, the St. John's-wort, and the rowan, and of the strange beliefs which clung to the celandine, the hawkweed, and the fumitory. The etymologist will elevate the names familiar to us all into records of the origin and habits of our remote forefathers; he will disinter the fragments of myth and history which lie embalmed in the centaury, the pæony, the carline thistle, the flower-de-luce, and the herb Robert; he will tell us how the laburnum closes its petals nightly like a tired labourer, how the campion crowned the champions of the tournament, how the foxglove, the troll-flower, and the pixie-stool, bring messages from fairy land; how the scabious, the lungwort, the scrophularia, and the wound-wort, bear witness to the grotesque beliefs of a pre-scientific medical community. Of the botanist I need not speak. Not a flower that blows but will furnish him with the text of an eloquent discourse. Forms that yield to other men artistic and sensuous enjoyment only, lay bare before him secrets of structure and of function as wonderful as those which characterise his own bodily frame; suggesting each its truth of design, and natural selection, and adapted change, and mysterious organic force. In the fructification of the orchid, the stamens of the barberry, the hairs of the nettle, the leaf of the sundew, he reads lessons as profound and similes as graceful, as were taught to Chaucer, and Southey, and Wordsworth, by the daisy, and the holly, and the lesser celandine. Year after year he greets the early spring with an enthusiasm which his neighbours know not, as one by one his friends of many years, the snowdrop, and the violet, and the crimson hazel stigma, and the stitch-wort, and the daffodil, and the coltsfoot, come back to him like swallows from their winter sojourn out of sight. Year after year, as the seasons die away and the earth is once more bare, he looks back delighted on the pleasant months along which he has walked hand in hand with Nature; for he feels that his intelligence has been strengthened, his temper sweetened, and his love of God increased, by fellowship with her changes, study of her secrets, and reverence for her works.]

W. TUCKWELL

INSECT METAMORPHOSIS *

II.

MANY naturalists of eminence have insisted so strongly upon the connection of the growth of wings and metamorphosis, that I shall now proceed to examine into this part of the subject. These beautiful organs of flight, so elegant in their outlines, so exquisite in the artistic blending of their colours, so marvellous in their minute construction, are popularly associated with the perfection of insect life. A suspicion of their existence arises when the curious swathings of a pupa are examined; but it requires the patience of a Landois to trace these future glories of a butterfly within the chest of the caterpillar but lately escaped from the egg.

But in considering the relation of growth to metamorphosis, it must be remembered that some insects have no wings, and yet undergo metamorphosis, and that others possess organs of flight, and yet only submit to skin-shedding.

In describing the general form of the body of the larva, it was noticed that the openings for the passage inwards of the air tubes were visible on either side of each segment. The openings, or stigmata as they are called, of the second and fifth segments of the larva, whose structures have been already described in part, are very distinct, and they lead to large air-tubes which branch off in all directions, and especially send a twig backwards and forwards along the inside of the third and fourth segments respectively.

The openings, or stigmata, of the third and fourth segments, on the contrary, are blind ones, and do not lead to tracheæ or air-tubes; but the delicate offshoots of the second and fifth masses of air tubes pass inside close to them, and it is on these that the wings are developed as new organs, as new structures fashioned out of the protoplasm of the blood. The wings are acquired, and are added to the bulk of the belongings of the larva. They continue to grow and to be perfected during the whole of the life of the insect, until their function is called into action. They originate after the escape from the egg; but the structures, upon the consideration of which so much time has been spent this evening, originated during the embryonic or egg condition, and clearly do not advance through long stages of inutility and imperfection to one of use and perfect adaptation.

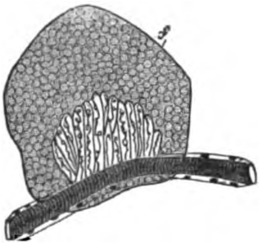

FIG. 7.—Wing-Cells

The first indication of the wing is observable in a caterpillar four millimetres in length, and one day after birth from the egg. The whole of the air-tubes are at that time as they are at all others covered by a very delicate layer of cells, which separates them, in fact, from the other tissues or blood, as the case may be, and with which they are in contact. Some flat and very small five-sided projections of delicate tissue are seen upon the fine air tubes running along the inside of the third and fourth segments.

There are four of these, two on either side, and the hinder are smaller, but are close to the front pair. In this stage they are composed of simple cells placed side by side to form the expansion of the tissue, and they rest upon and cannot be separated artificially or microscopically from the fine layer of cells which intervenes between their bases and the air-tubes. The tissues and cells of the air tubes remain intact, but these additional structures are fixed upon them, and are destined for a very different series of developments.

When the caterpillar has changed its skin for the first time, the expansions have increased in size and in complexity of structure. Each expansion is found to consist of a structureless, flat, pentagonal bag, which is very thin, and to contain a well-marked layer of globular cells of nearly equal sizes. Moreover, at the base of the expansion, where it rests on the cellular layer of the air-tube, a crowded group of elongated cells is observed resting on this layer, and situated amongst the globular cells and within the structureless expansion.

These elongated club-shaped cells are sometimes fusiform, and contain a structureless liquid, and attached within their equally structureless walls is a nucleus and its contents. They did not exist before the skin-shedding, but are readily observed subsequently to it. The expansions of this tissue consist of the three histological elements just noticed, and out of them the future wings are gradually developed.

After the second skin-shedding of the caterpillar, the expansions are found to have increased slightly in size; and a careful microscopical examination detects an excessively delicate and twisted cylindrical tube within each of the long cells which are situated at the base of the expansion, and which would be in contact with the air-tube, were it not for its investing cellular layer. The nucleus of the elongated cell has been absorbed, and its walls look thinner, and their tissues appear to have been observed to contribute to the twisted-looking thread which floats in the liquid contents. It is evident that this thread-like tube is connected through the cellular layer with the interior of the air-tube, but it is at present a simple tubular expansion of plain structureless membrane, and does not contain air.

Alterations progress in the developing wings during the interval between the third and fourth skin-sheddings, and they become sufficiently large as to be seen with the naked eye, for they have attained nearly one-tenth of the length of the whole caterpillar. The globular cells within the structureless membrane are found to have increased in size, and the delicate tubes of the elongated cells to have increased in length and numbers. The cell wall and nucleus are lost to sight in some instances, and the twisted tubular connection of the undermining air-tube may be observed to have passed here and there amongst the globular cells. At this time these tubes take on the appearance of air-tubes, and the delicate circular fibre which is seen in the other air tubes of the caterpillar is to be recognised.

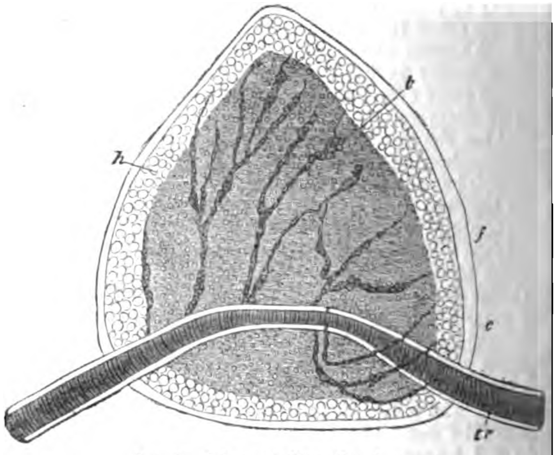

FIG. 8.—Advanced Wing Development.

The next stage appears to bring about an increase in the number, length, and size of these coils of air-tubes within the bag-like wing, and in the dimensions of the bag, but not of its contained globular cells.

By the time that the caterpillar leaves off taking food and begins to attach itself by its tail end, preparatory to skin-shedding for the last time, considerable progress has been made in the development of the wings. The cord-like air-tubes have grown sufficiently to reach nearly to the top of the wing, and they branch off in several directions. They contain air, and are surrounded by the layer of globular cells, but they are closer to the under side of the wing bag than to the upper. Moreover, the wing bag, so structureless hitherto, has acquired on its outside a glistening surface of extremely delicate cells, which is called epidermis. Beneath this coating is the main thickness

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* A Lecture delivered before the British Association, 1872, by Prof. Duncan, F.R.S., continued from p. 34.

he bag, and it is now found to be composed of large cells placed ide by side. Within it are the globular cells and the cord-like ranching air-tubes. By this time the wings which are visible n the 3rd and 4th segments have approached the inside of the kin of the caterpillar, and when this begins to separate before eing cast, a glutinous secretion covers them with the whole ody.

The structure of the wings immediately before this period ecalls that of the membranous expansions with which aquatic nsects are furnished, with the aid of which they breathe and nove more or less rapidly under water. But the changes on the vhole of the wing which occur at this time, and during the four r five early days of pupal life, soon make these organs complicated. The changes are, however, part of a progressive development. The wing veins, or nervures, without which the wings would be flaccid and useless, are formed irrespectively of the structures already described. Their path within the wings has been marked out by the coil-like air-tubes, but they are formed out of the protoplasmic matter which exists amongst the layers of globular cells, and are elastic cords surrounded by a cellular layer. Whilst they are developing, one or two wide air-tubes degenerate, and finally disappear. The veins of the wing are attached to the lower surface of the expansion so frequently alluded to, and they grow with the increasing area of the organs, so that during the early days of the pupa the wing consists of an expanded wing membrane, which is cellular, and which contains wing veins and large air-tubes, intermingled with a great number of globular cells.

The beautiful microscopic scales of the wing begin to be formed as soon as the glutinous case of the pupa is hardened, for air soon passes between it and the delicate skin and members beneath. By the fifth day all the wings are covered with recognisable scales and hair, and then for a certain time, depending upon temperature and the habit of the species, growth is arrested, and things remain *in statu quo*. When the time comes for emergence from the pupa case, the imago within awakens, as it were, from a long hybernation, and after splitting its case it comes forth a moist, weakly thing, with its wings crumpled upon its sides, wet and unable to move. The sunshine, the dry air, and the forcing in of air on the part of the insect into the large air-tubes of the wing, enable those organs to unfold, to increase in area, to become dry, and at last to be of use.

It has, I trust, been made evident that the wings are progressively developed, and that they grow from simple protoplasms into all their beauty and complexity of form during the stages after the escape from the egg.

They are acquired organs; they are given to the insect during its progress of change. Like the metamorphoses, they are superadded to the original condition of the embryo or the young within the egg. They are characteristic, to a great extent, of metamorphosis, and thus the notion that the organs and these states of change were both acquired and superadded is worthy consideration.

It now becomes necessay to inquire into the kinds of changes which insects submit to during their evolution after birth. There are perfect or complete, incomplete and retrograde metamorphoses, and some insects do not change their structures and habits at all

The cabbage butterfly and the false wasp afford examples of perfect or complete metamorphosis, the completeness consisting in the succession of an active larva, an immobile pupa, and an active imago with different habits to the larva. There is a variety of this kind which is of some importance, and it may be termed imperfect-complete metamorphosis. The silkworm is a good example of this variety, and the organs of its mouth are imperfectly developed. Such is also the case in many moths and insects which do not take food of any kind.

Incomplete metamorphoses are observed in those insects which have three stages of activity—active larvæ, pupæ which move and are then called nymphs, and active imagos.

The common gnat undergoes incomplete metamorphosis, and the dragon fly, which belongs to a different class, also. The gnats skim over the surface of stagnant water and collect their eggs together as they are laid one by one in a little boat-shaped mass, the whole being covered with a gummy coating. This floats, and the larva are hatched very soon from the under side. They commence a life of predacious activity, and undergo skin-sheddings. After one of these the insect comes forth, differing in shape from the larvæ. It swims with the aid of two large lamellæ, something like a fish-tail, and when it requires air it presents its back on the top of the water, and not its tail, as the larva did. This is because there has been an alteration in the disposition of the main respiratory tubes. These active pupæ, or nymphs, cannot eat or drink, and after swimming for some days they come permanently to the surface. Then the last stage of metamorphosis succeeds, and the tiny gnat escapes without wetting its delicate wings, and to pursue a life which is well known to you.

The nymph of the dragon-fly greatly resembles the larva, and it seizes prey in the water and devours it. When the time is come for the change into the fly the nymph crawls out of its element on to a leaf, its skin splits on the back, and the sanguinary and active dragon-fly comes forth.

In these instances there is not that distinction in habit and instinct which prevail amongst the insects gifted with perfect and complete metamorphosis.

Retrograde metamorphosis is a doubtful expression of some interesting facts. Sometimes a larva leads an active life, and is elaborately and perfectly formed; it changes into an immobile chrysalis, and then the imago comes forth not only with defective organs of mastication and motion, but also with indifferent legs and scarcely a vestige of wings. Or both wings and legs may be wanting, and there is not much resemblance to an insect left.

Thus the pretty caterpillar, which may still be found about geraniums, and which looks like a harlequin from its curious tufts of different-coloured hair, belongs to the vapourer moth. It is a perfect larva, and very active. The chrysalis, or pupa, is, like those of other moths, immobile and swathed. Two kinds of moths escape—the males, which are pretty and perfect moths, with elegant wings and great powers of fidgetty flight; and the females, which are ugly brown bags with small legs, scarcely a vestige of wing, and incomplete mouths. They are very unlike the male, and really have not the same activity, energy, power of locomotion, or complexity of structure as their larva.

Another species belonging to the genus Psyche has very pretty male moths, but the female has no wings, legs, or feelers, and looks like a helpless egg-bag. She never quits a curious case made up of parts of flowers, in which the caterpillar and the pupa lived.

It is quite clear that in these insects there is no progressive development from first to last in their metamorphosis.

Insects which do not undergo any metamorphosis are by no means uncommon, but they all submit to the skin shedding. Such insects are hatched from the egg, in shape and habit much resembling the adult or full-grown individual. A considerable number of the Orthoptera—insects which fold up their wings longwise, of which the earwig, the cricket, and the grasshopper may be considered as representatives—do not undergo the change in form and habit which is so characteristic of most of the Insecta. What alterations do occur are the progressive development of wings and of the reproductive organs and skin shedding. Most of the Orthoptera moult or change their skins repeatedly, some as many as three times, and still they do not alter in form; a fourth skin shedding finds others with rudimentary wings, which are small, crumpled, and visible. The fifth moult exhibits the insects with perfect wings and full-grown. There is no period of inactivity, and the insect pursues the same habits throughout its lifetime. Its tissues are not subjected to such changes as in those described.

Some few but very important and interesting kinds moult only three times, and never have wings; and others, which only moult four times, never have these organs in perfection.

To conclude this short review of the kinds of and exceptions to metamorphoses, it must be brought before your recollection that the unpleasant louse, the curious fish scale, and the podura, or skiptail, do not undergo metamorphoses, and that their skin sheddings are not attended by the development of wings.

Not only are there these varieties of change of structure and habits, but there are modifications of each of them which relate to the time and season at which metamorphosis takes place, and the duration of its stages.

The next step in the inquiry as to the meaning of all these changes in the philosophy of insect life, is to determine whether insects which resemble each other have the same kind of metamorphosis—in other words, whether identity of metamorphosis accompanies similarity of construction. Are the great groups into which the vast class of Insecta is divided by a natural classification, capable of being equally well and meaningly classified by the similarity or dissimilarity of their particular methods of change of structure and habit. The answer must be that, generally speaking, some of the groups which are widely separated by dissimilarity of structure, possess the same kind of metamorphosis, and that some groups which resemble each other more than others have not the same kind of changes.

It is impossible to classify the groups by their kinds of changes of structure and habit without outraging the first principles of a natural classification.

The next step in this inquiry is to decide whether all the members of any of the great groups are metamorphosed in the same manner, and whether there are any genera or species belonging to one group which are exceptional in their method of change, and which possess that common to the bulk of the insects of another group.

The answers are as follow:—

All the members of any great group are not subject to the same kind of change, but those of some very small families are; and some genera undergo a metamorphosis totally unlike their closest allies in a group.

There is a very good example of the difference in the mode of metamorphosis in some of the great groups, and of its evident independence of structural affinity or likeness to be gleaned by comparing the Orthoptera, the Coleoptera, and the Lepidoptera—the grasshopper, beetle, and butterfly tribes respectively.

There is a greater resemblance in structure and general arrangement of parts between the Orthoptera and the Coleoptera than between the Coleoptera and the Lepidoptera; yet the Coleoptera resemble the Lepidoptera in possessing complete metamorphoses, whilst those of the Orthoptera are incomplete or absent altogether. Again, many families of the great groups have genera whose species are influenced by very wide modifications of the same kind of change. Thus amongst a family of the Lepidoptera one kind passes through a perfect change like that already described. A closely-allied moth will pass through the change twice in the year; and in one the egg will remain unhatched through the winter; in another the pupa will last through the autumn, winter, and spring; in a third a perfect insect will hybernate through the water; in a fourth a caterpillar will be born, will feed and increase in size, but will not turn to a pupa at once. It will hide up and hybernate for months, and will be metamorphosed in the early spring. In a fifth a caterpillar will crawl from the egg in August, and will not eat; but it hides up and hybernates until the early summer, when it crawls forth and eats and passes through a perfect metamorphosis. All these modifications, so irrespective of seasons, may be noticed in closely-allied genera. The lace-wing family, or the Neuroptera, are a very natural group, and their separation from other forms, on account of the general dissimilarity of construction, is as perfect as any classification will permit. In this family all the kinds of metamorphosis are to be noticed. Some genera, like the dragon-flies, undergo incomplete metamorphoses, and have active nymphs, which do not differ much from the larva; whilst others, like the scorpion-flies and the caddis-flies, are subjected to changes as perfect as those of a butterfly or moth, although their structures are very diverse.

Seeing, then, that insects which so closely resemble each other as to be placed as allies in every classification that follows the order and system of Nature have to undergo different kinds of change of structure and habit, it becomes necessary to admit that the original structures of a species assumed their form according to a law which did not regulate the metamorphoses. These have no relation with the origin of the species, and are independent of the anatomy of the individual. Like the structures of the wings, the stages of the metamorphosis are acquired and superadded. It is credible enough that these wonderful and various changes are for the benefit of the creatures undergoing them; and doubtless there has been in every instance a mysterious relation between these and external physical conditions at some period or other. The metamorphoses are for the protection and preservation of the species, and may be esteemed extraordinary aids in the struggle for existence. The fact of there being Insecta which do not undergo metamorphoses, but only the skin sheddings which are common to certain Arachnida, Myriopoda, and Crustacea,—all the Articulata, is very important in studying the philosophy of this knotty subject; so also is the fact that the orders of Insecta which contain both these non-changing forms, and others which have a very incomplete metamorphosis, are of vast geological age. Probably these Neuroptera and Orthoptera were the first insects—certainly they were amongst the oldest. These considerations must be associated with the method of development of wings—those acquired organs which are, nevertheless, not present in some non-metamorphosing Insecta.

The most convenient hypothesis by which the origin of metamorphosis may be explained, and that which appears to be most consonant with facts, is to be comprehended under the following heads:—1. The insecta have a great geological age. 2. The earliest did not undergo metamorphoses, but simply shed their skins. 3. The first forms were wingless Neuroptera or Orthoptera. 4. That in order to meet the influence of changes in external physical conditions during the evolution of varieties of the original forms, the metamorphoses were acquired. 5. Incomplete metamorphoses preceded the complete. 6. Organs of flight were acquired independently of metamorphosis. 7. The kind of metamorphosis depended upon peculiarities in the external conditions, and its determination was defined by law.

If the phenomena of metamorphosis and the growth of wings have been acquired, and were not implanted in the original species to follow at once and inevitably, there should happen, and there ought to happen—according to the analogy of nature—instances where the part or the whole of the acquisition is absent.

The degraded and almost wingless vapourer moth, the wingless Psyche, the wingless condition of the female of the winter moth, and the useless wings of Climatobid, must have arisen, not by disuse, but by reversion to the ancestral condition. Why should the gall-flies that affect the roots of the oak have no wings, and those which make galls on the branches have them only in the male, whilst the makers of the corresponding structures on the leaf are perfect in their wings and metamorphosis? The idea of disuse will not apply; and certainly the wingless would enjoy wings and make them useful. They are reversions to the ancestral type. There is a little false wasp called Metilla: it belongs to a tribe eminently characterised by advanced instincts, and rapidity and power of variation of flight; yet the female is wingless, and low in its instincts. The wings would be useful to the insect, and the males of an Australian species certainly think so, for they carry their wingless ladies about with them under great difficulties. It is, like the others, an instance of reversion. On the other hand, the acquirement of the gift of imperfect metamorphosis may have been followed by that of the complete kind, and then to that of the elaborate and apparently enigmatical changes undergone by some parasites, may have been superadded.

Habits and instinct which change contemporaneously with the structural metamorphoses were doubtless acquired and are handed down, generation after generation, in obedience to the law of the descent and inheritance of useful gifts. Wonderful as the acquisition is of certain mental powers at certain periods in such humble things as insects, still it must be remembered that man inherits mental peculiarities, which become evident at different successive times of his life. A boy inherits mental peculiarities which characterised the youth of his parents, and others become evident in his adult age, which peculiarised his father or mother at the same period. How, is beyond the question and the fact is enough.

Sometimes, by examining the instincts of a group of closely allied species of insects, and by noticing and comparing slight differences in their habits and metamorphoses, a hint may be obtained how some very recondite peculiarity may have been acquired and been transmitted, provided it were beneficial to the creature. The most interesting instincts of the Odynerus which were mentioned at the commencement of this lecture, were the forming a tubular antechamber and provisioning the chamber with stung grubs for an offspring which it never saw. A considerable group of mining false wasps make or excavate chambers to lay their eggs in, and they, one and all, are in constant terror lest some interloper or parasite should enter their underground workings, during their absence in search of food for the future offspring. On arriving with the stung larva at the mouth of their hole, which is closed up carefully by some before flying off, they enter and run into the chambers in a great state of excitement to see that the nursery is not taken possession of by an intruder who intends to stop. So impressed is this instinct upon them that, if the prey which is left outside during the rapid inspection be removed a little way off, when it is replaced by the insect the process of examination is repeated, and the insect will do this over and over again, senselessly it is true, but in obedience to an inherited and almost automatic impulse.

There is no doubt that a great number of futile egg laying ʀisionings occur amongst those tribes on account of the entry arasitic insects who devour everything. So that an additional inctive act which could produce any alteration in the shape or ngement of the tunnel and chamber-making, which would efit and tend to preserve the future larva, would assuredly be petuated by descending to subsequent generations. The ante- mber of Odynerus meets every difficulty and want. Its ile nature will not permit the intruder to pass along without aking it down and covering the hole in the tunnel, and when broken down by the dying insect it effectually closes up the ae of its labour and hides the offspring from harm. The only sfactory hint which can be gleaned respecting the origin of the visioning of chambers in which an egg is left, is obtained by ore's study of the habits of *Bembix vidua.* This mining wasp s an egg which hatches very shortly, and the little mother its its living offspring every day and brings it small larvæ, ng to keep them quiet at first, and then larger larvæ as the le cannibal increases in size. All this time the Bembix is a etarian, but she is known to sip the honey which may be on ne of her victims.

The instinct of a Bembix may have been altered by its eggs hatching, and a series of victims may have been placed in the amber automatically, instinctively, and without what is called ason. There is of course the possibility of memory existing ring the quiescent stage. Does the butterfly remember its istence as a gormandising caterpillar, and therefore retain some tion of the propriety of laying eggs over cabbages? Does e Odynerus fly remember its underground life, and obey some pulse to provide the unseen offspring with food different to at which she loves? It is possible; and as nothing is too won- rful for psychologists, there may be something in the suggestion.

It is evident that the influence of external conditions which e antagonistic to the comfort and well-being of many insects is ten neutralised by a happy and protective contemporaneous ange of form and habit. On the contrary, as in the instance f larvæ which hybernate and do not turn into pupæ before evere weather sets in, or in the case of hybernating butterflies, ll connection between existing external conditions and the time nd nature of the metamorphosis is often indistinguishable. But this apparent anomaly may be explained when it is remembered how long-lived many species and genera of insects are, how persistent some forms have been through considerable geological periods, and to what numerous changes of climate they may have been exposed during forced emigration, or even whilst being on the same area. The commingling of several insect faunas which must have occurred over and over again during the later geological period of the world's history, will quite account for closely allied forms presenting modifications of the general kind of change of structure and habit.

All the relations of the metamorphoses to changes in the inorganic kingdom of nature, *i.e.*, to alterations in the external physical conditions surrounding insect forms, is doubtless within the scope of law. The insect host is innumerable, and the variations in external physical conditions must have been repeated during vast ages; yet the kinds of metamorphoses and their modifications are few in number and are singularly pronounced.

NOTES

A VERY large number of noblemen and gentlemen, members of the Society of Arts, have signed a memorial to Her Majesty's Government, in which, after referring to the great benefit conferred by the opening of the Bethnal Green Museum, and the immense number of people (upwards of 700,000) who have visited it in three months, they "submit that this museum could never have come into useful existence, and have been instrumental in conferring these benefits on the people, without the aid of Parliament; and they desire to press this fact upon the consideration of Her Majesty's Government, with the hope that they will submit to Parliament the policy so essentially national of voting increased means to facilitate the establishment of museums, libraries, and galleries of Science and Art in large centres of population, wherever such localities are willing to bear their share in the cost."

THE list of candidates for the Mathematical School at the University of Oxford numbers 132, against 206 in the Classical. Of these, 14 are candidates in honours. In the Natural Science School there are eight candidates for the Final Examination, all in honours.

AT a meeting of the Arts School at Cambridge this week, a discussion arose on the report of the Museums and Lecture Rooms Syndicate, recommending the erection of additional accommodation for students in physiology and comparative anatomy. Mr. J. W. Clark and Prof. Humphry warmly advocated the adoption of the report, the latter remarking that the sum was small, compared with that expended at Leipsic, Amsterdam, and other parts of Europe. No decision appears to have been arrived at.

AN anonymous friend has just given to the Council of the Midland Institute the large sum of 2,500*l.*, to be expended in scholarships for encouragement of the study of practical physiology, more especially that branch of it which is concerned in the amelioration of the sanitary condition of the poor. This noble gift is prompted by remarks which were made by Canon Kingsley in his opening address to the Midland Institute.

THE *Academy* announces the recent death, at Göttingen, of the great mathematician Klebsch, at the age of forty.

A LARGE number of eminent physicians, chemists, and others belonging to various countries in Europe, have formed themselves into a union for the laudable purpose of constructing a general European Pharmacopœia. At the meeting of the Pharmaceutical Society, on November 6, Dr. Thudichum gave an interesting address on the subject, in which he showed that during the last 200 years many men had tried to realise the idea of a general pharmacopœia; but as these attempts were mostly made by single individuals, each of whom endeavoured to carry out his own idea in his own way, failure was necessarily the result. It is likely that the present co-operative attempt will be more successful.

M. BABINET, of the French Academy, whose death we recently chronicled, was born at Lusignan in 1794, educated at Metz, and entered the Artillery, which he quitted in 1815. After having been Professor of Physics in the College of Fontenay-le-Comte, and afterwards at Poictiers, he went to Paris in 1820, to occupy a chair of Physics in the College St. Louis. Until 1864 he was also Examiner to l'École Polytechnique in Physics, Descriptive Geometry, Applied Analysis, and Geodesy. His lectures at the Athenæum on Meteorology did much to foster a taste for the study of atmospheric phenomena. He was elected to the Academy in 1840 in the section of Physics. Previous to this he had distinguished himself in various ways, having done much to perfect the pneumatic machine, for which the Academy awarded him a prize. Besides this, he invented a goniometer, which bears his name, and in many memoirs recorded his optical experiments and researches, besides doing much to popularise scientific studies. The best of what he has written is collected in his "Études et Lectures sur les Sciences d'Observation."

TWO very interesting letters on Arctic Exploration appear in the *Times* of Tuesday last. Capt. J. C. Wells writes that he met Prof. Nordenskiöld's expedition when returning in Mr. Smith's schooner yacht *Samson* from a cruise to the north of Spitzbergen. The arrangements appeared very perfect, but the vessels were in no way fitted to contend with the ice. Captain Wells is of opinion that the North Pole may be reached during the summer months. The vessel should leave England in April, to enable her to arrive at the edge of the pack beyond Spitzbergen early enough to take advantage of the breaking of the ice from the edge of the main pack. Her return might be looked for in October of the same year. "At the present time," he adds, "Austria, Germany, Sweden, France, Russia, and even Italy, are in the field, striving, either by actual exploration or by tentative efforts, to form expeditions to reach the North Pole, simply for the advancement of science, while England alone remains inactive." Mr. B. Leigh Smith also writes that he met with the expedition inside the Norway Islands near Hakluyt's headland, on August 29. He believes they have made themselves comfortable for the winter months, somewhere on the north coast of Spitzbergen, and that no vessel has any chance of reaching them now.

PROF. CORFIELD has been elected Medical Officer of Health to the parish of St. George, Hanover Square. Dr. Corfield's appointment will make a vacancy in the Officership of Health to the parish of St. Mary, Islington. Mr. Haviland and Dr. Tidy will, we understand, again contest that appointment.

WE learn from the *Medical Times and Gazette* that there will be a vacancy for a Demonstrator of Anatomy in the Charing Cross School of Medicine. A salary of 150*l* is attached to the office. Among the candidates is, we understand, Dr. Murie, late prosector to the Zoological Society.

FROM the same journal we learn that the Chair of Medicine at the Royal College of Surgeons, Ireland, is now vacant through the resignation of Dr. Charles Benson, who had so long and ably discharged the duties connected with it. We learn that several candidates have already entered the field, and that the selection of a professor will take place early in December. Among the candidates are Dr. Samuel Gordon, Dr. James Little, Dr. Henry Kennedy, and Dr. Arthur Wynne Foot. The emoluments are about 150*l*. per annum.

THE French Government has lately struck a medal in commemoration of the discovery in 1868 by Dr. Janssen and Mr. J. N. Lockyer of the method of observing the sun's chromosphere without an eclipse. The medal bears on the obverse the portraits of Dr. Janssen and Mr. Lockyer, and on the reverse the chariot of the Sun, with Phœbus indicating the prominences round an uneclipsed sun.

MR. GLADSTONE and Mr. Darwin having declined the Lord Rectorship of Aberdeen University, about to be vacated by Mr. Grant Duff, M.P., the contest lies between Prof. Huxley and the Marquis of Huntley, the Arts students mostly preferring the latter, and the medical students the former.

PROF. SPAETH has been elected Rector of the University of Vienna.

THE Natural History Mastership at Clifton College is now vacant, through the appointment of Mr. Barrington Ward to an Inspectorship of Schools. The teaching of Botany, Geology, and Physical Geography, and the elementary teaching of Mathematics, are comprised within the duties of the office, as well as the Curatorship of the Museum and Botanical Garden.

IF anyone desires to know how lecturing, and especially scientific lecturing, is managed and rewarded in America, let him (or her) forthwith obtain "The American Literary Magazine and Lecture Season," published at the "American Literary Bureau." Here he will find the names of lecturers willing to lecture on all conceivable subjects, with the fees they are prepared to charge, varying from 50 to 250 dollars per lecture; while one lecturer, Mr. Froude, stands alone in his glory, priceless. The accuracy of this appraisement of talent is however somewhat marred when we read further that "to *some of the above* traveling and hotel expenses are added," while "terms may be modified for weak organisations and deserving charities." The managers of the bureau frankly announce that "a lyceum course must be pushed like any other business," while they give the managers of these institutions the valuable advice to "ignore all party or sectarian bias and choose brains." On the principle of "catching your hare," they therefore furnish the lyceums with eighty pages of choice of lecturers and subjects, advising them to pursue the plan of ranging "from gay to grave, from lively to severe," and give [illegible] their patrons "at least one concert, one reader, one lecture (not too heavy), and one humorous lecture.' Quackenbos, in "Words considered humorously, and wise," an extensive programme, is undeniably cheap while Mr. Waterhouse Hawkins nicely values his subjects from "The Age of Dragons" to "The Uni of the animal kingdom, at from $100 to $112. Dr. lecture on "English Institutions as Educational Hindr from $100 to $125. Generals, Reverends, and ladies, the favourites of American audiences. Who will not bureau where they can have a choice of Prof. "Darwinism" for $100, and Miss Kate Stanton on " to Marry" for $50? Although this may appear enough to English ears, yet it has its serious and useful side. Some similar plan of providing unity and of organisation among English scientific lecturers of very great value. Will the scheme now under of the British Association effect this?

THE following is from the *School Board Chron* years ago the Federal Polytechnicon of Switzerland unknown hands a legacy of 50,000 francs, accompanied closed envelope, which, according to the testator's was not to be opened until ten years afterwards. having now elapsed, the envelope was found to cont 'Johannes Schoch, citizen of Fischental.' The merly migrated to Milan, and there, by his judgm dustry, acquired a large fortune. The object of the to secure competent teachers for the Polytechnic

THE Royal Institute of Science, Literature, and Venice, offers a medal of the value of 3,000 francs awarded in 1874 to the author of the best essay on the subject:—"The advantages derived by the medi especially physiology and pathology, from modern physics and chemistry; with a retrospective view of which prevailed in medicine in past times." The open to foreigners, and the essays may be written in

A PRELIMINARY meeting for the purpose of forming Microscopical Society, which has been talked of for was held on November 1, at St. Bartholomew's Hospital deal of discussion ensued on the proposed society, from the various hospitals were appointed as a comm

THE family of the late Prof. Sir James Y. Simpson sented a bust of the distinguished physician to the Edinburgh. It has been placed in the library hall.

WE understand, says the *British Medical Journ* medical students of the University of Aberdeen prop a medical journal, which shall appear once a fortni advanced students will act as editors. It bears the *Aberdeen Medical Student*. The undertaking shows ing vigour in the Aberdeen school. We wish the the journal every success.

THE same journal informs us that the new ship of Comparative Anatomy at the University will have an endowment of 300*l*. or 400*l*. a year first holder will, we believe, undoubtedly be Macalister, Professor of Zoology; and in future chairs will go together, with an endowment, 600*l*. or 700*l*. a year. Practically, the election considered as virtually decided. Trinity College in future two Professors of Anatomy—viz.: 1. Pure Human and Comparative; 2. Mixed Anatomy, or Surgical Anatomy. They will each have an income Both professors must attend two hours daily in the room. [illegible]

E learn from *Harper's Weekly* that the Hon. James Knox, of xville, Illinois, U.S., now in Berlin, has presented Hamilton ege, U.S., with 10,000 dollars for the improvement and wment of its hall of natural history.

HE following is from the *British Medical Journal*:—"Two sian ladies, Misses Olga Stoff and Sophie Hasse, have em- ed themselves during the autumn recess in investigating the ulation in the spleen, by means of injection and microscopic mination. Their researches, which were made on the spleens rogs, pigeons, rabbits, mice, rats, and various other animals, well as of the human subject, were carried on in Dr. Frey's oratory. They have published an account of their examina- and its results in the *Centralblatt* for Nov. 9."

MEMORIAL portrait of the late Rear-Admiral Sir James ss, the great explorer, subscribed for by several naval officers l men of science, has recently been placed in the Painted Hall the Royal Hospital, Greenwich. What Sir James Ross did North Polar exploration is well known.

THE 119th session of the Society of Arts commenced yesterday ening, when the opening address was given by Major-General Eardley-Wilmot, F.R.S., Chairman of the Council.

THE first course of the Cantor Lectures for the ensuing season l be on "The Practical Application of Optics to the Arts, nufactures, and to Medicine," by C. Meymott Tidy, M.B., int Lecturer in Chemistry and Professor of Medical Jurispru- ice at the London Hospital, and will consist of five lectures, to delivered on the evenings of Nov. 25, Dec. 2, 9, 16, and 23. second course will be given during the session by the Rev. thur Rigg, M.A., "On the Energies of Gravity, Electricity, tality, Light, and Heat, especially with reference to their asurement and utilisation."

THE winter course of lectures at the Museum of Science and t, Edinburgh, commenced on the evening of Nov. 18, with first of a series on "Chemistry," by Prof. Crum Brown. An eresting programme has been arranged, including, among ier items, six lectures by Prof. Geikie on the "Superficial rmations of Scotland," and as many on "Sound" by Prof. it.

ACCORDING to the latest bulletin from Regent's Park, young ppo, whose birth we chronicled a fortnight ago, and who is w sixteen days old, is thriving famously, being plump and ll-developed, standing firmly on his legs, trotting briskly about er his stupendous mama, and imitating all her actions. It is be hoped that the admirable precautions taken by those in arge will be successful in preserving the life of the little stranger l it can take care of itself.

THE following is from the *Athenæum*:—"The Maharajah of shmere is desirous of having several scientific works translated m the English into the Sanscrit language; and as he under- nds that there are many able scholars in England and Germany, has placed the matter in the hands of Col. Nassau Lees, who to select competent persons for the work. His Highness has d some works already translated in Calcutta. He has requested at, as the first instalment of the European series of translations, of. Liebig's work on Chemistry, or some other standard work the same subject, should be one of the works translated. An d ertaking of this sort ought to prove most useful."

IT is understood that Dr. Schweinfurth, the eminent German eographer, is about to return to Central Africa with a view of ontinuing his explorations, especially in the line of botany. His brother, a merchant at Riga, has contributed a large sum of oney, the interest of which is to be used by Dr. Schweinfurth his present undertaking; the principal afterwards to be given o the Polytechnic School at Riga to found a prize to defray the travelling expenses of such explorers in the future as have been students of that establishment.

WE hear that a most important desideratum in Biblical Archæology has been supplied by the diligence of Mr. George Smith, of the British Museum, who has discovered among the Assyrian Records an account of a deluge similar to that recorded in Genesis. Mr. Smith will read a paper on the subject next month before the Society of Biblical Archæology.

WE learn from *Harper's Weekly* that with commendable enterprise Messrs. Maynard & Dean, of Massachusetts, announce their intention of publishing a periodical entitled *American Ornithology*, to be devoted to the scientific and popular history of birds. It is to appear bi-monthly, at the rate of five dollars a year, and will consist in part of popular articles on birds, and in part of more elaborate and technical memoirs. Each part will consist of about forty pages, and will contain a coloured plate of some new or little-known American species. In view of the difficulty of sustaining special journals, this enterprise is one of no little daring, but will, we trust, be justified by the result. At present there are but two periodicals exclusively devoted to birds; one of them, the London *Ibis*, published quarterly; the other, the *Journal für Ornithologie* of Cabanis, published bi-monthly in Leipsic.

MR. WORTHINGTON SMITH records in the *Gardener's Chronicle* some very curious cases of "mimicry" in fungi. He mentions several instances in which a rare fungus so closely imitates another common one belonging to a different sub-genus or even genus in all superficial characters as to be with difficulty distinguished from it, and is always found in company with it. It is difficult to conceive that this "mimicry" is of any value to the "mimicing" fungus except, as Mr. Smith suggests, that it has certainly hitherto prevented the detection and consequent destruction of rare fungi by collectors!

WE learn from the *Academy* that Prof. Tschermak has published a new catalogue of the meteorites in the Vienna collection. At the date of issue (October 1, 1872) the mineralogical museum contained specimens representing 182 falls of meteoric stones, and 103 falls of meteoric iron. Letters appended to the name of each aërolite in the list indicate its position in a classification which has been based chiefly on the constituent minerals, certain distinctive physical characters of these minerals also being used in arranging them in subdivisions.

THE Haggerstone Entomological Society, which was established in 1868, and is composed of working men, commenced, on Thursday evening last, its Annual Exhibition at No. 10, Brownlow Street, about a hundred yards from the Haggerstone Station on the North London line, and it is well worth a visit. The members are all practical entomologists, meeting one evening a week for the study of the science, with the aid of a good cabinet of Lepidoptera, and other facilities for advancement; and this fifth exhibition shows that they have not worked in vain. Among the specimens, which are at once rare and varied, are some fine ones of the *Vanessa antiopa*. This is one of the rarest butterflies found in this country, but during the last season it was (as we announced some time ago) far more abundant than it had been for many years before, and the Haggerstone collectors seem to have bestirred themselves accordingly.

WE have just received the winter programme of the Chester Society of Natural Science (President, the Rev. Canon Kingsley), and a hopeful one it is, showing that the members are no mere *dilettanti*, but are anxious for work likely to produce results of high value in all the three sections into which it is divided—Botany, Zoology, and Geology. Their district is the four squares on the old Ordnance map of which Chester is the centre, and much has already been done by the members to elucidate the natural history of that district, although the Society has existed only 18 months. It numbers over 300 members. Dr. Stolterfoth and Mr. Liddell are energetically working the Diatomaceæ and Foraminifera of the Dee, and lists of these, we believe, will shortly be published. Several other members are actively at work in all three departments; the results of this work we hope to see in a permanent form. On the 27th inst., the President, Canon Kingsley, will read a paper on "Deep Sea Dredging," and on January 30, Professor Boyd Dawkins one on his favourite subject—"Cave Explorations."

We learn from the *Athenæum* that the Government of Colombia, or New Granada, has extended for five years the grant to Mr. José Triana to enable him to publish in London, in Spanish, "La Flora Colombiana," and the Botanical Geography of Colombia.

We are glad to learn that a good deal of attention is being given to the systematic study of science in Glasgow by members of the teaching profession actual and prospective. Mr. E. M. Dixon, B.Sc. (London), one of the lecturers in the Established Church Normal Training College, has for several sessions regularly given a very comprehensive course of instruction in physiology to the male students in training; and this year the female students have been introduced to the study of botany by Mr. Robertson, another of the lecturers in the Glasgow Training College. It is understood that the Free Church Normal College is also about to do something in science teaching. Mr. John Mayer, F.C.S., has, during the last few years, had large classes of pupil teachers in physiology, and of schoolmasters and assistant-schoolmasters in physiology, chemistry, and metallurgy, the class for teachers being held on Saturdays, so as to be suitable alike for town and country students. It is evident that Scotland is becoming more alive to the value of science as a means of intellectual discipline and culture. In many little towns and villages north of the Tweed, special science classes are now in course of establishment for the first time.

We learn from the *Journal of Botany* that a Flora of Portugal is announced as in preparation by Señor Baroo de Castello de Paiva. It will include all the additions made since 1804, the date of Brotero's excellent Flora Lusitanica.

AMERICAN SCIENTIFIC INTELLIGENCE*

THE arrangements for an extended exploration of the Pacific Ocean by the Navy Department of the United States, have been brought almost to a conclusion, and it is understood that the *Portsmouth*, under Captain Skenett, will leave New York about the middle of November for the scene of operations. The vessel will proceed, with only the necessary stops, by way of Cape Horn, to the west coast, and will commence her work in the Gulf of California. Two years will probably be spent in the investigation of the hydrography of the peninsula, including the entire gulf region, as also in the exploration of the Revillagigedo group of islands. A subsidiary object, to receive a due share of attention, will be a general investigation into the physics and natural history of the deep seas and of the adjacent islands. Dr. Street, the surgeon of the expedition, has already distinguished himself as a naturalist and a collector in the Darien expedition, and will doubtless win new laurels on the present occasion. The astromomical department will be in charge of Paymaster Tuttle, well known as the discoverer of an asteroid and of a telescopic comet. The *Narraganset*, now on the Pacific station, has also been detailed for the same service, and will probably refit at Callao for the purpose. There are few portions of America more interesting in a natural history point of view than that to be immediately explored by this expedition, the Galapagos themselves being scarcely more noteworthy. This is shown by the researches of Mr. Xantus and of Colonel Grayson. The former gentleman spent several years at Cape St. Lucas, in the service of the United States Coast Survey and of the Smithsonian Institution, and obtained large numbers of specimens in all branches of natural history, many of which were entirely new to science. Colonel Grayson, in his explorations of Socorro Island, one of the Revillagigedo group, found that, as at Cape St. Lucas, there were many animals peculiar, or unknown elsewhere, most of them being then undescribed. They have, however, lately been published by Mr. George N. Lawrence, in a memoir of the collections of Colonel Grayson.—Professor Marsh announces the very important discovery of fossil quadrumana in the eocene deposits of the Rocky Mountains. The genera *Limnotherium*, *Thinolestes*, and *Telmatolestes* are, in his opinion, closely related to the lemurs, especially in the correspondence of the larger bones. The teeth are more numerous than in any known quadrumana, some species having apparently forty—namely two incisors, one canine, and seven premolars and molars on each side of each jaw. The professor also describes a new genus of large carnivora, under the name of *Limnofelis latidens*, in which the canines and premolars of the lower jaw resemble those of the hyena, but with only two incisors on either side. The single species *Oreocyon latidens*, is supposed to have been as large as a [illegible]. Another novelty consists in a cretaceous reptilian, allied to *Mososaurus*, and possessing peculiar characteristics. The animal has been called *Colonosaurus mudgei*, after the discoverer, Professor Mudge, who obtained the remains in Western Kansas.—Mr. J. F. Whiteaves, of Montreal, has completed his investigations into the deep-sea fauna of the Gulf of St. Lawrence, already mentioned as undertaken in continuance of those of last year; and he is now engaged in preparing his report for presentation to the Minister of Marine and Fisheries, at Ottawa. The greatest depth reached by him was 310 fathoms off the south-western end of Anticosti, where he obtained a *Virgularia*, and specimens of *Pennatula* additional to those secured last year. He also found an interesting cup-shaped coral about an inch across the disc. — Recent advices from Mr. Stevenson, director of the Snake River division of the United States Geographical Survey, under command of Professor Hayden, announce the arrival of the combined party at Fort Hall on the 11th of October, the Snake River Basin having been carefully explored by them. The party reached the Geyser Basin the last of July, having obtained supplies from Virginia City, *viâ* Madison Valley. They followed the Madison River to its source in a small lake, and crossed the "divide" to Madison Lake, which they found to have no connection with Madison River, but with an outlet about one hundred feet wide, flowing in an opposite direction from the one given on the maps. They followed this to its entrance into another lake about five miles wide, and which proved to be the real source of Snake River. They found a geyser basin near the source of Snake River, with about two hundred springs of all sizes, some of which spouted eighty to one hundred feet in height. Mr. Stevenson divided his party above the Snake River Cañon into two portions, one of which passed through the cañon, and the other explored the Teton Pass, both meeting again at the lower end of the cañon. The division under the immediate direction of Professor Hayden reached Bozeman on the 14th of October, having completed the season's labours. Every step is said to have been a success, and the amount of valuable material of scientific and practical value to far exceed that of any previous year. The Professor and his assistants proceed at once to Washington to prepare the report, to be presented to Congress for publication at an early date. Just before closing his field labours Professor Hayden's party had explored the Gallatin River to its source, and completed the examination of the Yellow Stone, descending it to Mount Shields River, thence returning to Three Forks. He expected to visit Helena before proceeding to Washington, for the purpose of determining its latitude and longitude. His astronomers had already fixed the geographical position of Virginia City, Fort Ellis, and Fort Hall.—One of the most striking of the many interesting discoveries of vertebrate fossils made in the wonderfully rich formations of the West is that of a fossil bird obtained by Professor Mudge in the upper cretaceous shale of Kansas, and described by Professor Marsh. The remains indicate an aquatic form about the size of a pigeon, but differing widely from all known birds in having biconcave vertebræ. The rest of the skeleton, however, is quite similar to that of the average type. The species has been named [illegible]

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* Communicated by the Scientific Editor of *Harper's Weekly*.

ON THE ECLIPSE EXPEDITION, 1871*

UNDERSTAND my duty to-night to be to give an account of the observations made, not by all who observed the lipse of last December, but by the members of the party which ent out under the auspices of the British Association; and it is tremely fortunate that nothing more is required of me—first, ecause most valuable work was done by the other parties, which itself would require more time to state than I have at my disposal; and secondly, because the amount of material obtained y the members who were sent out from England, and by the iends who met them at every point, is so great, that it would e impossible in one discourse to give anything like an exhaustive count of it. Here are some of the records in this portfolio. ou will see at once that even for one party I can only make a election, and I am perfectly aware of the extreme responsibility hich attaches to anyone who may venture to make a selection ut of such an enormous mass of material as we have collected.

Before I proceed to discuss the work done by the different arties, it will be desirable to give an idea of the arrangements, nd for this purpose I have prepared several maps which will nable you to see what the British Association parties did.

In the first instance I may remark that the weather conditions were somewhat problematical. Another point of great importance was that much of the ground was fortunately occupied, and t was essential, when placing the parties, to bear these two considerations in mind—the possibility of bad weather, and then the mportance of so arranging matters that if some of the observers were clouded out, belonging to our parties, then the story might be continued by other observers.

Here we have a map of India, which gives you a general idea of the path of the shadow during the eclipse. The shadow, you see, strikes India on the western coast, and it runs down in a south-westerly direction, and cuts the northern portion of Ceylon.

When we arrived in India we found that the Indian observers, consisting of those well-known men Tennant, Herschel, Hennessy, Pogson, and others, had determined, from their knowledge of the climatic conditions of India at that time of the year, to occupy the central part of the line, and also a station at a low level; the eminent French physicist M. Janssen taking up his position at the top of the Nielgherries. We were to station ourselves either east or west, or both, of these parties. Whether east or west would depend upon the monsoon, and the great question that was being discussed on our arrival was, Was the monsoon favourable?

I have not time to go into the many interesting points touching the answer to this question; but I may say shortly that what we heard was, that if the weather was likely to be bad on the east side of the hill range, generically called the Ghauts, there was a good chance for anyone occupying a position west of those hills. What happened was that we did occupy the positions marked by blue wafers on the map, namely, Bekul on the west coast, Manantoddy on the western slope of the Ghauts, Poodocottah in the eastern plain, and in the island of Ceylon, first, Jaffna, and secondly, Trincomalee.

Such were our arrangements. The parties were stationed along the line of totality. Very different were the arrangements of the Sicilian party of the former year. In Sicily we were compelled to throw ourselves *across* the line of totality in the direction which I have indicated on this map of Sicily.

Now what was the work we had to do? If you will allow me to refer to two or three results of the former Eclipse Expedition, I will endeavour to put them before you without taking up too much of your time.

One of the most important among the results obtained in the eclipse of 1870 was this: far above the hydrogen which we can see every day without an eclipse—far above the prominences, the spectrum of hydrogen had without doubt been observed by two or three of the American observers, who were more fortunate than we were. Among them Prof. Young stated that the spectrum of hydrogen was observed to a distance of 8 minutes from the sun; he then adds, "far above any possible hydrogen atmosphere." This is point number one.

Another of the points was this: the unknown substance which gives us a line coincident, according to Young, with a line numbered 1474 by Kirchhoff, had been observed by the American observers to a height of 20 minutes above the limb of the dark moon.

Now, it was a very obvious consideration that if we got a spectrum of hydrogen 8 minutes from the dark moon, when we thought we knew that the hydrogen at the sun did not really extend more than 10 seconds beyond the dark moon, there was something at work which had the effect of making it appear very much more extensive than it really was; and it was fair to assume that if this happened in the case of the hydrogen, it might also happen in the case of the unknown stuff which gives us the line 1474.

In support of this view we had one of the few observations which were made in Sicily, in the shape of a drawing of the corona, as seen by Prof. Watson, who observed at Carlentini. He saw the corona magnificently; and being furnished with a powerful telescope, he made a most elaborate drawing of it, a rough copy of which I will throw on the screen. You will see at once that we had in this drawing something which seemed to militate against the idea that the 1474 stuff at the sun did exist to a height of 20 minutes. According to Prof. Watson the boundary of the real corona was clearly defined, its height being far under that stated.

Next, we had another observation of most important bearing on our knowledge of the base of the corona. I refer to the announcement of the observation by Prof. Young of a stratum in which all the Fraunhofer lines were reversed. It was asserted that there was undoubtedly a region some 2 seconds high all round the sun, which reversed for us all the lines which are visible in the solar spectrum. We had, in fact, in a region close to the photosphere the atmosphere of the sun demanded by Kirchhoff at some distance above the photosphere.

Last, not least, we had the photographic evidence. There was in Sicily a photographic station in Syracuse, and the Americans had another in Spain. I now show on the screen a drawing—it is not the photograph itself—but a drawing of a photograph made by the party in Sicily; what we have on this photograph is a bright region round the dark moon, which is, undoubtedly, solar, but stretching out right away from this, here and there are large masses of faint light, with dark spaces between them, which have been called rifts. Now the question is, Is this outer portion solar?

Having thus brought rapidly before you some of the questions which we had principally to bear in mind, and, if possible, settle (though that is too much to hope for in any one Eclipse Expedition) in the work we had to do in India, I will next bring to your notice some new methods of inquiry which had been proposed, with the object of extending former observations.

I may here remark that the Royal Astronomical Society, in the first instance, invited me to take charge of an expedition to India merely to conduct spectroscopic observations; but although this request did me infinite honour, I declined it, because the spectroscope alone, as it had been used before, was, in my opinion, not competent to deal with all the questions then under discussion. I have told you that some of the most eminent American observers had come to the conclusion that the spectrum of hydrogen observed in the last eclipse round the sun, to a height of 8 minutes, was a spectrum of hydrogen "far above any possible hydrogen" at the sun. Hence it was in some way reflected. Now with our ordinary spectroscopic methods it was extremely difficult, and one might say impossible, to determine whether the light which the spectroscope analysed was really reflected or not; and that was the whole question.

It became necessary, therefore, in order to give any approach to hopefulness, to proceed in a somewhat different way in the 1871 expedition; and, in order to guard against failure, to supplement such new observations by photographs; and fortunately we were not long in coming to a conclusion that this might be done with some considerable chance of success.

I have here a train of prisms. I will for one moment take one prism out of the train, and we will consider what will happen if we illuminate the slit of the lantern with a monochromatic light, and observe it through the prism. If we render sodium vapour incandescent, we know we get a bright yellow image of the slit, due to the vapour of the metallic sodium only giving us yellow light. But why is it that we get a line? Because we always employ a line for the slit. But suppose we vary the inquiry? If, instead of a straight line we have a crooked line for the slit, then we ought to see a crooked line through the prism.

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* A Lecture delivered at the Royal Institution of Great Britain, Monday, March 22, 1872, by J. Norman Lockyer, F.R.S. (The chief results obtained by the expedition have been taken from the *ad interim* Report presented to the British Association Meeting at Brighton. The lecture itself dealt mainly with the methods and instruments employed.—J. N. L.)

Now, allow me to go one step further: suppose that instead of a line, whether straight or crooked, we have a slit in the shape of a ring, shall we see a ring through the prism? You will see that we shall. And then comes this question: If, when we work in the laboratory we examine these various slits, illuminated by these various vapours, why should it not happen that if we observe the corona in the same way, we shall also get a ring built up by each ray of light which the corona gives to us; since we know, from the American observations, that there were bright lines in the spectrum of the corona, as observed by a line slit? In other words, the corona, examined by means of a long train of prisms, should give us an image of itself painted by each ray which the corona is competent to radiate towards us.

Now let us pass to the screen, the screen merely replacing the retina. We will first begin with the straight slit with which you are familiar—we now have our slit fairly focussed on the screen—we then in the path of the beam interpose one of these prisms, and there we get on the screen a bright line.

Now, to continue the argument, we replace the straight slit by a crooked one, and you see we get a crooked image on the screen. We now replace this crooked slit by a ring. We have now a ring-formed image on the screen. So that you see we can use any kind of narrow aperture we choose, and as long as we are dealing with light which is monochromatic, or nearly so, we get an image of the aperture on the screen.

If we consider the matter further, it will be evident that we may employ a mixture of vapours, and extend this result.

We will now, for instance, instead of employing sodium vapour, employ a mixture of various vapours. You see now that each ray given by these substances, instead of building up a line image, is building up for us a ring image—that we have now red, green, yellow, blue, and violet rings.

Now that was the consideration which led to the adoption of one of the new attempts to investigate the nature of the corona used this time. It was, to use a train of prisms, pure and simple, using the corona as the slit, a large number of prisms being necessary to separate the various rings we hoped to see, by reason of their strong dispersion. On the screen the rings to a certain extent intersect each other; and it would have been easier to show you the ring-form of the images if we could have used more prisms than one.

If this is good for a train of prisms such as I have referred to, it is good for a single prism in front of the object-glass of a telescope. Such was the method adopted by Prof. Respighi, the distinguished Director of the Observatory of the Capitol of Rome, who accompanied the expedition.

Now you may ask how would this method, if it succeeded, be superior to the ordinary one? In this way. If we were dealing merely with reflection, then all the rings formed by vapours of equal brilliancy at the base of the chromosphere would be of the same height, while if reflection were not at work, the rings would vary according to the actual height of the vapours in the sun's atmosphere, and the question would be still further advanced if the spectrum did not contain a ring representing the substance which underlies the hydrogen.

Our *new* spectroscopic equipment then was as follows:—

1. A train of five prisms.
2. A large prism of small angle placed before the object-glass of a telescope.
3. Integrating spectroscopes *driven by clockwork.*
4. A self-registering integrating spectroscope, furnished with telescopes and collimators of large aperture, and large prisms. (This instrument was lent by Lord Lindsay.)

Now a word about the polariscopic instruments, referring you to my lecture given last year for a general notion of the basis of this class of observation.

A new idea was that observations to determine the polarisation of the corona might be made with the same telescope and eye, both with the Biquartz and the Savart.

By the kindness of Mr. Spottiswoode, who has placed his magnificent polarising apparatus at our service, I hope to be able to show you on the screen the mode of examining the corona by means of those two instruments, so as to enable you pretty well to follow what was actually done.

Let me begin with the Biquartz polariscope. In the first instance I will throw on the screen a representation of the corona itself, and we will then insert a Biquartz, and see its effect when I flood the screen with polarised light. You now see an indication of what would be observed supposing the polarisation was due to polarised light diffused in the region between us and the dark moon and eclipsed sun, in which case the polariscopic effect would be observed generally over the dark moon, the corona and the region of the sky outside the corona. But this is not all; not only does this arrangement enable us to determine the existence of such a general polarisation, but the vertical line in the Biquartz called the line of junction indicates the plane of polarisation, when the colours on both sides of it are the same; so that we have two colours strongly contrasted in either half of the field when we are away from the plane of polarisation, and a uniform colouring of the whole field when in or at right angles to that plane. By turning this prism through 90 degrees, you see I entirely change the colours.

But we are not limited to the Biquartz in this inquiry. We can apply the Savart polariscope. Having still our image of the corona on the screen, I now replace the Biquartz by a Savart.

We now no longer see a line of junction with the similar or different colours on either side of it, but lines of colour running across the image. I turn the prism. We first see the lines with a white centre, then with a dark one; while at times they are altogether absent. And as a departure from the plane, when we use the Biquartz, gives us the strongest contrasts of colour, so you observe that with the Savart under these circumstances all indications of polarisation vanish.

Now, if we assume polarisation to be general, and the plane of polarisation vertical, we should get those coloured bands, as you see them there, crossing the corona and dark moon, the lines being vertical and dark-centred. If the plane of polarisation were horizontal, we should find the lines horizontal and the central one white.

But so far as we have gone, we have been dealing with polarisation which is general, and we have not attempted to locate polarisation at the corona itself. But I have here an apparatus by means of which, quietly, in this theatre one can see as admirable an example as we should desire of polarisation assumed to be particular to the sun and not general—I mean radial polarisation. We have simply a circular piece of mahogany, or something else which polarises light equally well, with a hole in the middle with sloping sides, cut as you see this cut, and then we place behind it a candle, so that the light of this candle, after falling on oiled tissue paper stretched across the aperture, can be reflected to the eye by the sides, the direct light of the candle being stopped by a central metallic diaphragm. We have now a source of polarised light of a different kind from the last. The next thing we have to do is to introduce into a small telescope exactly the same kind of apparatus we have there, though of course on a much smaller scale, and examine the ring of light seen when we put the candle behind the aperture. On examining the ring of light which is now visible by means of this telescope, which contains a Biquartz and analyser, I see the most exquisite gradations of colour on either side the line of junction which divides the field of view and the bright ring in the centre into two.

Now, instead of the candle, we will employ the electric lamp, and instead of the eye, the screen; but I must inform you that the great heat of the electric lamp prevents the appearance being perfectly successful on the screen, as the reflecting varnish is melted.

In this experiment we cannot work with an image of the corona. We must make our corona out of the image of the ring we hope to get on the screen; and then, by employing the Biquartz in the same way as before, instead of getting similar colours on either side of the line of junction, as we did when we were working in the plane of polarisation, and getting the greatest contrasts, as we did when we worked 45 degrees from it, you observe we get different colours in each part of the ring.

On the screen we now have a highly-magnified image of a hollow cone of iron which I am compelling to reflect the light from the lamp; and by inserting this Biquartz I throw various colours over different portions of that ring, which I beg you to consider for one moment as the solar corona, and the colours change as I rotate this prism. You will at once be able to explain the different actions of this Biquartz in this instance. The reflection, and therefore the plane, of polarisation is no longer general, but varies from point to point of the reflecting surface. It is in fact radial, and hence the delicate radiate arrangement of colour.

Such, then, were some of the new methods and new instruments we used for the first time in our researches. And I hope you will allow me to use this term, although our work was conducted a long way from the Royal Institution, the natural home of research in England.

(*To be continued.*)

SOCIETIES AND ACADEMIES

LONDON

eological Society, Nov. 6.—Prof. Ramsay, F.R.S., ., in the chair. A Report by F. T. Gregory, Mining Land missioner in Queensland, on the recent discoveries of Tin- in that Colony. According to this report, the district in ensland in which tin-ore has been discovered is situated it the head-waters of the Severn river and its tributaries, prising an area of about 550 square miles. The district is ribed as an elevated granitic table-land intersected by ranges brupt hills, some attaining an elevation of about 3,000 feet ve the sea. The richest deposits are found in the beds of the ams and in alluvial flats on their banks, the payable ground ring from a few yards to five chains in extent. The aggregate gth of these alluvial bands is estimated at about 170 miles, average yield per linear chain of the stream-beds at about ten s of ore (cassiterite). Numerous small stanniferous lodes have n discovered, but only two of much importance, namely, one r Ballandean Head Station on the Severn; and another in a f of red granite rising in the midst of metamorphic slates and dstones at a distance of about six miles. The lodes run in allel lines bearing about N. 50° E.; and one of them can be ced for a distance of nine or ten miles. The ore, according Mr. Gregory and Mr. D'Oyly Aplin, is always associated with granite, *i.e.* "the felspar a pink or red orthoclase, and the ca generally black; but when crystals of tin-ore are found *in* , the mica is white." The crystals of tin-ore are generally ind in and along the margins of quartz threads or veins in nds of loosely aggregated granitoid rock, but are sometimes bedded in the micaceous portions. The report concludes with me statements as to the present condition and prospects of the strict as regards its population.—Observations on some of the cent Tin-ore discoveries in New England, New South Wales, G. H. F. Ulrich. The district referred to by the author in the most northern part of the colony of New South ales, almost immediately adjoining the tin-region of Queens- nd described in the preceding report. It forms a hilly evated plateau, having Ben Lomond for its highest point, early 4,000 feet above the sea-level. The predominant rocks re granite and basalt, enclosing subordinate areas composed f metamorphic slates and sandstones; the basalt has generally roken through the highest crests and points of the ranges, and pread in extensive streams over the country at the foot. The orkings of the Elsmore Company, situated on the north-west ide of the Macintyre river, about twelve miles E. of the town- hip of Inverell, include a granite range of about 250 feet in eight, and nearly two miles in length. The granite of the ange is micaceous, with crystals of white orthoclase, and is tra- ersed by quartz veins which contain cassiterite in fine druses, eams, and scattered crystals, and by dykes of a softer granite, onsisting chiefly of mica, and with scarcely any quartz, in which assiterite is distributed in crystals, nests, and bunches, and also n irregular veins of several inches in thickness. This granite ields lumps of pure ore up to at least 50 lbs. in weight. The uartz veins contain micaceous portions which resemble the "Greisen" of the Saxon tin mines. The deepest shaft sunk in one of the quartz veins was about 60 feet in depth. The author noticed certain minerals found in association with the tin ore, and the peculiarities of the crystalline forms presented by the latter. In conclusion the author referred to the probability that a deficiency of water may prove a great obstacle to the full development of the tin-making industry in this district, but stated that "it seems not unlikely that the production of tin ore from this part of Australia will reach, if not surpass, that of all the old tin-mining countries combined."—"On the included Rock-fragments of the Cambridge Upper Greensand." By W. Johnson Sollas and A. J. Jukes-Browne. The occurrence of numerous subangular fragments in the Upper Greensand formation was so far remarkable that it had already attracted the notice of two previous observers (Mr. Bonney and Mr. Seeley), who had both briefly hinted at the agency of ice. While ignorant of the suggestions of these gentlemen, the authors of this paper had been forced to the same conclusion. A descriptive list had been prepared of the most remarkable of the included fragments. The infallible signs of the Upper Greensand origin consisted in incrustations of *Plicatula sigillum*, *Ostrea vesiculosa*, and "Coprolite," without which, it was stated, the boulders would be undistinguishable from those of the overlying drift. The following generalisations were then put forward:—1. The stones are mostly subangular; some consist of friable sandstones and shales, which could not have borne even a brief journey over the ocean bed. 2. Many are of large size, especially when compared with the fine silt in which they were imbedded; the stones and silt could not have been borne along by the same marine current. 3. The stones are of various lithological characters, and might be referred to granitic, schistose, volcanic, and sedimentary rocks, probably of Silurian, Old Red Sandstones, and Carboniferous age. Such strata are not found *in situ* in the neighbourhood, and the blocks must have come from Scotland or Wales. Numerous arguments were adduced in favour of their Scottish derivation. The above considerations, that numerous rock fragments, some of which are very friable, have been brought from various localities and yet retain their angularity, were thought sufficient evidence for their transportation by ice; the majority showed no ice scratches, but the small proportion of scratched stones in the moraine matter borne away on an iceberg, and the small percentage of ice-scratched boulders in many deposits of glacial drift, show that the absence of these striæ is not inconsistent with the glacial origin of the included fragments. Besides this the stones of the Greensand consisted of rock, from which ice marks would readily have been removed by the action of water. The authors stated, however, that they had found more positive evidence in a stone which was unmistakably ice-scratched, consisting of a siliceous limestone, and preserved in the Woodwardian Museum. The fauna, so far as it proved anything, suggested a cold climate; though abundant, the species were dwarfed, in striking contrast to those of the Greensand of Southern England and the fauna of the succeeding Chalk. The authors concluded that a tongue of land separated the Upper Greensand sea into two basins, the northern of which received icebergs from the Scottish-Scandinavian chain; the climate of this was cold, that of the southern basin much warmer.

PARIS

Academy of Sciences, Nov. 4.—M. Faye, President.—The first paper read was by M. Becquerel, on the solar origin of atmospheric electricity. A large portion of the paper was preliminary, and contains a sketch of modern solar discoveries; the subject is to be continued.—M. Pasteur then read a note on the production of alcohol by fruits. His remarks referred to some experiments by M. Lechartier, who has found that alcohol is developed in fruit on simple keeping.—Another note by the same author followed, replying to some of M. Fremy's late assertions. To this M. Fremy replied, and was immediately answered by M. Pasteur, who demanded the appointment of a commission to examine his experiments, when M. Fremy arose and proposed that he, M. Pasteur, and M. Trécul should work in common. M. Dumas then stated that the Academy should grant the request of M. Pasteur. M. Wurtz supported M. Pasteur's demand, and M. Pasteur then asserted that he would not agree to M. Fremy's proposed joint work, and urged the appointment of a commission to examine the contested experimental evidence. After this the discussion dropped.—Another of MM. Favre and Valson's papers on crystalline dissociation was then read. The authors described a new method for the investigation of the "coercive" action of a salt on water at any temperature.—M. Faye then read a paper on Mr. L. Rutherfurd's lunar photographs.—Next came a report on a memoir by Dr. Dufossé on the noises and sounds which the sea and freshwater fish of Europe can hear. The report recommended that the thanks of the Academy should be awarded to the Doctor for his discoveries. M. Max Marie then presented a paper on the elementary theory of Integrals of any order, and of their periods. M. Becquerel then presented an addendum to M. E. Jannettaz's late note on the coloured rings of gypsum. The note by M. Jannettaz contained some additions to and corrections of his former communication.—M. D. Colladon then presented a note on the effects of lightning on trees, which was referred to the Lightning Conductor Commission. MM. Becquerel and Edm. Becquerel made some remarks on this paper in relation to the change in colour of stricken trees and flowers.—M. C. Dareste's third part of his paper on the osteological types of the osseous fishes followed, and was sent to the Anatomical and Zoological section.—M. Sainte-Claire Deville then presented a memoir by M. F. Fouqué on some new processes for the proximate analysis of minerals, and on their application to the lavas of the late eruption of Santorin.—The *Phylloxera* Commission next received a proposal from M. de Wissocq, proposing calcic sulphide and hydrosulphuric acid as remedies for the diseased vines.—M.

Yvon Villarceau then presented the elements and ephemerides of the planet 125, calculated by M. G. Leveau. This planet was discovered by M. Henry at the Paris Observatory. Astronomers having powerful instruments are requested to observe it, and communicate their results, as it is exceeding difficult of observation.—M. Maurice Lévy then communicated a paper on the theory of equations of partial differences of the second order of two independent variables.—Next came a continuation of M. Th. du Moncel's paper on the accidental currents which are developed in telegraphic lines, of which one end remains insulated in air.—Next followed a note by M. P. Yvon on a photometer founded on the perception of relief, and a note on the action of a copper and cadmium couple on a solution of cadmic sulphate, by M. F. Raoult, and M. P. Havrez's paper on the formulæ for the laws of colour, and number of "Chevreulian" tints connected with the doses of different generating agents.—This long paper was followed by a note on the paces of horses, studied by the graphic method, by M. E. J. Marey. Several traces of trot and gallop movements accompanied the paper.—Mr. Grace Calvert sent a paper on the power of certain substances in stopping putrefaction and preventing protoplasmic life, which was then read, and followed by a note on the febrifugic and anteperiodic properties of the leaves of *Laurus nobilis* by M. A. Doran, and by a paper on the causes of intermittent fevers, and the means of prevention and cure, by M. E. Ferrière—M. Picot then read a paper on the "antifermentescible" properties of sodic silicate. M. Ch. Robin presented a note by M. E. Dubrueil, on the Capreolus of *Zonites Algirus*. This was followed by a note by M. Carbonnier on the reproduction and development of the telescope fish. This fish is of Chinese origin, its name being Long-tsing-ya in Chinese (*Cyprynus macrophthalmus* Bloch). M. Claude Bernard then presented a note by M. L. Ranvier, on the annular strictures and inter-annular segments of the rays and cramp-fish.—Another communication from M. Thomas on his asserted discovery of fluorine was submitted to the examination of M. Balard.—M. Le Baron Larrey presented an extract from M. Berenger-Féraud, naval surgeon-in-chief at Senegal, on the larvæ and flies (*mouches*) which are developed in the human skin. At the conclusion of the paper M. Émile Blanchard made some remarks on it as regards the Cayor fly, no specimens of which have yet reached Europe. M. Chevreul then presented a copy of M. Paul de Gasparin's work on the "Valuation of Arable Land in the Laboratory;" and after some remarks from him on M. Gasparin's discovery of phosphoric acid in the subsoil waters of the Plain of Orange, the session was adjourned.

Nov. 11.—M. Faye, President.—The first paper was by Capt. Perrier on the determination of a great geodesical base in Algeria.—The President followed with a paper on the triangulation of Algeria for the new military map of the province.—M. Becquerel then read the second part of his paper on the solar origin of atmospheric electricity. He considers that the protuberances come from solar volcanoes, and that they are charged with positive electricity.—A letter from M. Faye to the author on his last paper followed.—M. Le Verrier then read a note on the determination of the secular variations of the elements of the four planets—Jupiter, Saturn, Uranus, and Neptune.—Next came a paper by M. Trécul on the origin of the lactic and alcoholic ferments. The author is very severe on M. Pasteur, who, he states, if 999 experiments are favourable to spontaneous generation and one against it, adopts the one and rejects the 999. This, of course, drew a reply from M. Pasteur, and his reply an answer from M. Trécul.—M. Pasteur then read a note on M. Fremy's paper read at the session of Nov. 4. M. Fremy answered M. Pasteur's criticisms, and M. Pasteur in a few words of answer again demanded a commission of inquiry.—M. Dareste then presented the fourth part of his researches on the osseous fishes, after which two papers on aerostation, by M. Hopin and M. Lamole respectively, were sent to the commission on that subject.—MM. Paul and Prosper Henry then announced the discovery at Paris, on the night of November 5 and 6, of two planets—126 and 127 of the 11th and 11·5 magnitude respectively; and M. Yvon Villarceau then read a letter on the two planets by M. Stephan, who had received information and observed them at Marseilles.—Next came a paper by M. H. Durrande on the acceleration in the displacement of a system of points which remains homographic with itself. At the conclusion of this came a paper on "Chloride of Lime" (bleaching powder), by M. J. Kolb. The author gives a method of valuation of this important commercial product.—M. Balard then presented M. Scheurer-Kestner's note on the loss of sodium in the preparation of soda-ash by Le Blanc's process. The author decides that the loss occurs in the "waste," and augments with the excess of lime compounds.—M. Wurtz presented a note by M. G. Bouchardat on the neutral combinations of Mannite and its hydrates.—M. L. de Saint-Martin presented some researches on Santonin.—This was followed by MM. Legros and Onimus, with experimental researches on the physiology of the pneumogastric nerve; and by an account of "Experimental Researches on the Functions of the Brain," by M. E. Fournie.—M. Brogniart then presented MM. Renault and Grand'Eury's paper on the Fossil Botany of the *Dictyoxylon* and its specific attributes.—M. Béchamp then gave an account of some researches on the function and transformation of mildews.—M. Pasteur presented a note by MM. G. Lechartier and F. Bellamy on the "Fermentation of Fruits."—M. A. Gaudin next read a note on "Some arguments necessary to clear up the fermentation question;" after which came a note by M. A. Leclerc on the Estimation of Manganese in soils and vegetables. After some observations on the geometric markings of microscopic algæ from M. J. [illegible] the session was adjourned.

DIARY

THURSDAY, November 21.

Royal Society, at 8.30.—On the Mechanical Conditions of the Respiratory Movements in Man: Dr. A. Ransome.—Further Experiments on the [illegible] Important Physiological Changes induced in the Human [illegible] Change of Climate: Dr. Rattray.—On Linear Differential Equations [illegible] and VII: W. H. L. Russell, F.R.S.

Linnean Society, at 8.—On the *Compositæ* of Bengal: C. B. Clarke, F.L.S.—On Diversity of Evolution under one set of External Conditions: Rev. J. T. Gulick.

Chemical Society, at 8.—On some New Derivations of Ambrafine: [illegible] W. H. Perkin.

SUNDAY, November 24.

Sunday Lecture Society, at 4.—On the Renaissance of Modern Europe; a Review of the Scientific, Artistic, Rationalistic, Revolutionary Results dating from the 15th Century: J. Addington Symonds.

MONDAY, November 25.

Royal Geographical Society, at 8.30.

TUESDAY, November 26.

London Institution, at 4.—On Elementary Physiology: Prof. Rutherford

WEDNESDAY, November 27.

Royal Society of Literature, at 8.30.—On Difficult Words and Passages occurring in Shakespeare's Works, Part I.: Dr. C. M. Ingleby.

Society of Arts, at 8.—On Technical Education, and the Means of promoting it: Thomas Webster.

London Institution, at 7.—On Spontaneous Movements in Plants: A. W. Bennett.

Society of Telegraphic Engineers, at 8.—On Lightning: W. H. [illegible]

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Errata.—Vol. vii. p. 14: in the article on "Scottish Coal Fields" for "Prof. Geikie" read "Mr. James Geikie."—Vol. vii. p. 15, col. [illegible] on lecture arrangements at Royal Institution, the second announcement should have read thus—"Twelve Lectures on the Forces and Motions of the Body, by Prof. Rutherford, F.R.S.E.; Three Lectures on [illegible] by Dr. Debus," &c.

THURSDAY, NOVEMBER 28, 1872

FERMENTATION AND PUTREFACTION*

IT is one of the great attractions of the science of Botany, an attraction common to all the other branches of the study of Nature, that wherever we may happen to be, and under whatever circumstances, something interesting and suggestive is continually brought before the eye and mind educated to understand its teachings, and no true naturalist ought long to be in a difficulty seeking for a suitable subject for illustration. At this season of dearth of flowers I hold in my hand a basket of "Duchesse" pears. These have, after their kind, been plucked in France before they were ripe, and some few of them are hard, green, and flavourless; others are soft, full, and mellow, with a rich, delicate aroma—morsels fit for the gods—while others have gone too far, and show the

> —"little pitted speck on garner'd fruit,
> That rotting inward slowly moulders all."

If you will allow me, I will, during the few minutes still at my disposal, give you a brief sketch of what has been done of late towards the explanation of the two phenomena which are for the moment the most prominent in connection with these pears, their ripening, and their decay.

These changes depend upon *fermentation* and *putrefaction*, two processes which are very familiar, and which have of late engaged the attention of some of the most able and skilful men of science, both on account of their vast importance in the economy of nature and of art, and of the singular phenomena which accompany them. These phenomena are very complex and difficult; but chiefly through the patient researches of botanists such as De Bary on the one hand, and of chemists and physiologists who may be represented by Pasteur, Lister, Burdon Sanderson, and Hartley on the other—steady progress is undoubtedly being made towards their solution, although much still remains obscure.

The character which most broadly distinguishes the vegetable from the animal kingdom is certainly the power which the former possesses when taken in mass of winning over from the inorganic kingdom binary compounds which cannot contribute directly to the nutrition of animals, decomposing them, and re-combining their elements into organic compounds suitable for the support of animal life. This process—the decomposition of water into oxygen and hydrogen, of carbon dioxide into carbon and oxygen, and of ammonia into hydrogen and nitrogen, and the re-combination of these four elements while in a nascent condition into starch, sugar, gum, protoplasm, &c.—is, so far as we know, carried on in plant-cells containing endochrome under the influence of light, and in such cells and under such circumstances alone. We thus find that this truly vegetable process is performed by a very small portion of an ordinary plant. The cells of the internal organs of plants and of large pulpy masses, such as these pears, connected with the function of reproduction, are perfectly colourless; simple sacs of cellulose, containing in their early condition protoplasm, and increasing and multiplying by its agency; and afterwards containing other substances in addition, such as starch and sugar, the products of its assimilation and excretion. These masses of protoplasm with their investing membranes composing the so-called "cells" of the pear, feed, indeed, upon the ternary and more complex compounds produced by the leaves of the pear tree, and are aërated by the fluids which are passing through the tissues of the pear tree; but, secluded from the light, and developing no special colouring matter, their reactions are not in the strict sense "vegetable;" they absorb the organic compounds and breathe the distributed air in the true animal sense, just as *Amœbæ* would do. To take the function of respiration as a test, they absorb oxygen and exhale carbon dioxide, while in the green parts of plants, which alone perform the great function of the vegetable kingdom in keeping up the "balance of organic nature," the exhalation of carbonic acid is in the sunshine entirely masked by the exhalation of oxygen—the product of its decomposition. A green tree may be likened to that wonderful animated tree, one of the oceanic Siphonophora, where a certain set only of the polyps are set aside to feed and to supply nutrition for the whole, while others, identical with these in essential structure, feel, or sting, or reproduce the species, or palpitate through the water as locomotive swimming-bells.

It is, perhaps, not easy at once to realise this difference in the vital relations of the different parts of the same plant, but it becomes clear enough in the case of pale parasites, for example *Cuscuta*. The dodder possesses no endochrome cells of its own; it feeds like an animal upon the organic compounds elaborated by its host. It contributes in no way as a vegetable to the balance of organic nature, and yet it is evidently a plant nearly allied to the ordinary bird-weeds, with all the characters of their well-known natural order.

These "Duchesse" pears are separated from the tree. They were probably separated physiologically before they were taken off, for before we would consider them fully ripe a certain shrivelling takes place in the cells and vessels of the fruit-stalk at a kind of joint, and the communication between the pears and the tree is at first partially and then entirely interrupted. But the pear does not die; it hangs out in the sunshine, and certain chemical changes take place within it, still under the guidance of vital action, sweetening it and developing its flavour. We learn from the beautiful researches of M. Bérard that if fruit be placed to ripen in air or in oxygen gas, a considerable quantity of oxygen is absorbed and an equivalent proportion of carbon dioxide is given off; that, in fact, a notable quantity of oxygen is burned in a true process of respiration. It is calculated by De Bary that the number of plants in which chlorophyll is absent—that is to say, which have no power of decomposing and re-combining the elements of water, carbon dioxide, and ammonia, and which consequently require to have their food presented to them in the form of organic matter—is fully equal to that of green plants, say 150,000. These plants are chiefly fungi. The part they play in the economy of the organic world is wonderful. The moment a plant gets worsted in the battle of life, becomes delicate from uncongenial soil or other circumstances, or gets smothered by a more vigorous rival, they set upon it and burn it.

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* From the Opening Address for the Session 1872-73 to the Botanical Society of Edinburgh, delivered on Nov. 14, by Prof. Wyville Thomson, F.R.S., President of the Society.

If we look just now in the Botanic Garden at any of the old summer beds of half-hardy plants, we shall see them shrouded in a maze and network of white fleecy mould. That mould is a fungus finishing the work of extermination which the frost has begun, and then burning the bodies. In all the odd corners there are heaps of rotting vegetation. These stems and leaves are not rotting of themselves; heat them to 212° F., so as to kill the seeds of the fungi, and seal them up in closed cases, and although they will slowly decompose, they will never rot. They are being burned by the process of respiration of fungi just as effectually as they would be if they were collected into a heap, dried, and set fire to. Most of these fungi are very minute, but each of them, when it is found in anything like a well-developed condition, is thoroughly characteristic. Still they are so small and so simple that it is difficult to distinguish parts of those organs whose form is not strongly marked.

I will give a brief sketch of the life-histories of one or two of these fungi, and the first I will choose is a well-known mildew, *Mucor stolonifer*. This species is often found on juicy fruits, covering them with white woolly patches scattered over with small black heads, and producing a very rapid putrefaction beneath the surface of the fruit. A number of delicate branching filaments form a rich network in the substance of the fruit, filaments which are easily distinguished from those of some nearly-allied forms by their long simple tubes without partitions. These delicate filamentous tubes, which are the parts first to appear, and form the basis, as it were, of the fungus, are called the *mycelium*, and are found in almost all fungi. From the mycelium, at certain points, long rather wide tubes start from the surface on which the fungus is growing obliquely into the air, and, after running along for a time, again dip down and give origin to other tufts of mycelium tube-roots. At the point where these roots come off, as at the bud of a strawberry-runner, a little tuft of tubular stems rises up vertically, and ends in round vesicles which at first are entirely filled with transparent protoplasm. These are cut off from the stem by a partition which is at first flat, but afterwards assumes an arched form, giving the space between it and the outer wall the shape of a very deep meniscus. The protoplasm in the space ultimately breaks up into a mass of black polygonal spores, which escape by the giving way of the outer wall of the sporangium. These spores are thus produced by no process of true reproduction, but are simply separated particles of the protoplasm of the parent plant. In hot summer weather, chiefly on the surface of sour fruit, *Mucor stolonifer* forms thick patches, with broad stolons, and from these, twigs spread over the surface of the fruit. When two of these twigs meet one another they form large vesicular expansions, and then apply themselves to one another. A diaphragm is formed across each of the vesicles, thus cutting off the distal end of the vesicle, which is filled with protoplasm. The double wall between the two cells gives way, and the protoplasm in the two unites, as in the union of the cell-contents in the conjugation of *Zygnema*. These "coupling cells" have thus become fused into a single cell called a *zygospore*, which goes on enlarging, and is covered with a thick skin.

The simple spores, when scattered on moist ground, send out filamentous shoots of mycelium, which in their turn originate stolons as before; but the zygospores do not produce mycelial filaments when they germinate, but form one or two sporangium-bearers directly at the expense of the substance of the zygospore, and the ordinary course of growth is resumed from their spores. There are thus two modes of multiplication in *Mucor*—one by sporangia and spores, non-sexual, a simple method of propagation by buds—the other a true reproductive process, by the conjugation of male and female elements. It seems to be only occasionally and under specially favourable circumstances that the latter process occurs, and this mildew often goes on reproducing itself by spores alone for many generations.

The life history of *Mucor mucedo*, one of the commonest of the mildews, is not yet thoroughly known. Here the cells are again simple and undivided, but each sporangium-bearer usually ends in several large sporangia. Under certain circumstances this sporangium-bearer sends out tufts of finely dividing twigs, each of which ends in a small sporangium, which, to distinguish it from the larger form, has been called a sporangiolum. At other times processes are produced from the main cells which rise into delicate tubular branches, and give off globular cells which are called *conidia*—simple external spores, differing entirely in their character from the spores produced in sporangia; and if this mould be grown in a solution in which it is fairly nourished without a full supply of oxygen gas, long fibres are produced which break up into a multitude of separate bead-like cells filled with protoplasm, and capable of reproducing the organism.

WYVILLE THOMSON

(*To be continued.*)

EXPLORATION OF THE SOUTH POLAR REGIONS

II.

WHILE Balleny was making the discoveries to whi we alluded at the close of the previous article, tw other expeditions were actively pursuing their researches and extending our knowledge of the Antarctic regions—a French expedition under Dumont d'Urville and a American under Lieutenant Wilkes. Neither expedition was originally intended for South Polar exploration, and to this among other reasons is it to be ascribed that the results, with respect to the exploration of the South P regions, are of but little value compared with those obtained by the almost contemporaneous English expedition.

From the South Shetlands D'Urville directed his course to the south, and discovered on February 27, 1838, in 6 10′ S. lat. and 57° 5′ W. long., a coast which bears the name of Louis Philippe Land, and rises to a height of between 2,000 and 3,000 feet above the sea. The general outlines of this coast were already indicated on Weddell's chart.

Two years later we find the same explorer again active and with a better result. In January 1840 he left Tasmania for the south, steering for the region between 1 and 160° E. long. On January 19, in 66° S. lat. h found land from 2,000 to 3,000 ft. high, entirely covered with snow and ice. On the 21st some of the sailors landed on a little island consisting of gneiss, which D'Urville named Adelie Land. On the 30th and 31st D'Urville sailed ound a promontory in 64° 40′ S. lat. and 132° 20′ W. long., aming this part of the coast Clairie Land. Shortly after his the expedition turned northwards, a number of the en having been lost through illness. Dr. Neumayer eems to think that the French constitution is not at all ell adapted for expeditions of this kind.

On February 25, 1839, four ships, under the command of Lieutenant Wilkes, set out from Orange Harbour n Terra del Fuego, for the purpose of exploring hese southern seas. The season was, however, too far advanced to admit of much being accomplished, though one of the ships, the *Flying Fish*, under Lieutenant Walker, penetrated as far south as the 70th degree of latitude in 100° 16′ W. long., and that at the end of March. This in itself is a fact of some interest and value, that so late in the season a point was reached as far south as Cook and Bellinghausen attained to, two months earlier.

On December 27 of the same year the squadron left Sydney, again for the south. Two of the ships, the *Flying Fish* and the *Peacock*, were soon compelled to return on account of injuries, so that there were only the two vessels, the *Vincennes* and the *Porpoise*, left to pursue their discoveries. On January 30, 1840, in 140° 2′ 30″ E. long., and 66° 45′ S. lat., Wilkes saw for the first time clearly and distinctly the land standing out of the mist; to this he gave the name of "Antarctic Continent." Five days previously the *Vincennes* reached its farthest south point, 67° in 147° 30′ E. long., where it was hard bestead by the ice. Indeed both vessels during their course along the coast had constantly to fight with the ice, and were frequently in the greatest danger of being crushed. Wilkes found the coast girt by a wall of ice, 150 to 200 ft. high, behind which rose the mountains to a height of 3,000 ft. He advanced thus to 98° E. long., and hoped on February 17 to be in a position to reach the point in this quarter to which Cook had come in 1773; but the ice-wall compelled him to turn to the north-east, quite away from the desired point. After he had followed the wall of ice to 62° S. lat. and 100° E. long., he had to give up all hope of being able to penetrate farther west, and returned to Sydney.

The expedition under Wilkes had travelled over a stretch of 1,500 miles along the margin of the ice, and frequently in sight of land. Even if through their labours the continuity of the land through its whole extent was by no means proved, yet the extension of Balleny's discovery in connection with that of D'Urville's considerably increased the probability of the existence of a great mass of land in these regions. Moreover, the observations made by Wilkes and his officers are of the highest value to science. It has been latterly disputed to whom belongs the merit of having first discovered the Antarctic Continent, both French and Americans claiming it each for themselves. But in the present state of our knowledge we must characterise such a dispute as perfectly objectless, for Balleny two years earlier had discovered his Sabrina Land, and had seen the coast at other points; therefore to him, if, indeed, an Antarctic Continent of the extent indicated by Wilkes exists, the honour of discovering it must be ascribed.

The researches initiated by Gauss and the Göttingen Society into the nature of the magnetism of the earth had given rise to a number of undertakings which had for their object to assist inquiry in this direction. From the southern hemisphere trustworthy data were altogether wanting, and on this account the British Government resolved to send an expedition to the magnetic South Pole, and that moreover, under the leadership of Captain James Ross, who had spent the greatest part of his earlier youth in the North Polar regions, and already in the year 1831 had discovered the magnetic North Pole. The results of his expedition, therefore, are incomparably rich and valuable.

After some preparatory cruising, the two ships, the well-known *Erebus* and *Terror*, well appointed for their work, set out from Hobarton on November 12, 1840, directing their course southwards, after a brief visit to Campbell Island. On December 27 the first ice was seen in 63° 20′ S. lat., and 176° 30′ E. long., and on January 1, 1841, the Polar circle was passed in 170° E. long., where the ships first encountered the pack-ice. Sir James, after careful consideration, determined to endeavour to penetrate the inner masses of pack-ice which, by the two previous voyagers, had only been skirted, and on the 9th, in 69° 15′ S. lat., and 176° 15′ E. long., came out into open sea. On the 11th land was discovered in 71° 15′ S. lat., the mountains of which, covered with perpetual snow and ice, reared themselves high into the air. The highest of these was named after Sir Edward Sabine, who for more than half a century, says Dr. Neumayer, has devoted his energies to researches in physical geography in all regions and in all parts of the earth, and who has largely added to our knowledge, especially of terrestrial magnetism.

The whole land, which Ross followed to nearly 79° S. lat., he named South Victoria Land, and an active volcano, 12,400 feet high, which he discovered on January 28, he named Mount Erebus. The name of the *Terror* was given to an extinct volcano, somewhat higher than the other, lying farther to the east. On the same day it was found that farther advance was impracticable, as the explorers found themselves suddenly face to face with an immense wall of ice, from 150 to 200 feet high, exactly similar to that which had been seen by D'Urville, Wilkes, and others. In the far distance over this wall they descried mountain peaks of great height and covered with ice: Ross named them after Parry.

In the vain attempt to reach the end of the ice-wall or find an opening in which the ship could pass the winter, they gained, on February 2, in 173° E. long., their greatest south latitude of 78° 4′. The rest of the month Ross spent in the further exploration partly of the southern sea and partly of the coast of the newly discovered Victoria Land from Franklin Island to the North Cape, when he turned his course to the west in 70° 40′ S. lat. In 68° S. lat. and 165° E. long. was seen a series of what seemed either islands or mountain peaks belonging to the continent, and farther on were seen the islands discovered by Balleny. Ross found that the land placed by Wilkes on his chart under 65° 40′ S. lat. and 165° E. long., in reality did not exist. As about the beginning of March the young ice began rapidly to form, Captain Ross determined to return northwards. On the return voyage, magnetic researches of the highest value were made. More especially was determined the position of the line of non-deflection of the compass.

On November 25, 1841, the expedition again shaped its course southwards. On December 16, in 57° S. lat., Ross reached the first ice, and on January 1, 1842, crossed the Polar Circle in 156° 28′ W. long., surrounded at times by pack-ice. On February 2, 1842, in 68° 23′ S. lat. and 159° 52′ W. long., the vessels reached open water, and on the 23rd of the same month, they approached, in 77° 49′ S. lat. and 162° 36′ W. long., a perpendicular wall of ice, only half the height of that in the neighbourhood of Mount Terror. On this day also they reached in 161° 27′ W. long. their highest latitude, 78° 9′ 30″ S., where they observed unmistakeable signs of neighbouring land. On the following day was commenced the return journey, and on April 6 the ships anchored at Port Louis, in the Falkland Islands.

On December 17, 1842, Ross set out a third time for the far south, this time to explore D'Urville's Louis Philippe Land, and to penetrate to the region which Weddell had reached in 74° 15′. There is little to record for our present purpose concerning this journey, but that, amid the greatest difficulties and dangers from the ice, the two plucky ships penetrated as far south as 71° 30′ in 14° 51′ W. long., on March 5, 1843. On September 2, the two ships *Erebus* and *Terror* reached England, and fifteen months later, under the guidance of Sir John Franklin, they set out again towards the north, from which they never returned.

Such is a brief review of the progress of geographical knowledge in reference to the South Polar regions. In what follows it is not intended to give a comprehensive analysis of the valuable material contained in the journals of the various voyages concerning the nature and physical conditions of these regions, but only to bring into prominence what is of greatest importance, and, in connection therewith, what is of importance to any expedition that may yet be organised, to draw some general conclusions as to the form of the South Polar regions. By this means a rational plan may be suggested for the further investigation of these regions.

In these observations the conditions as to ice claim our attention in the first place, as they enable us to draw important conclusions with respect to the extent of the land and the currents inside the Polar Circle. With reference to the latter, the drift-ice is of special value, as it enables us to recognise them in spite of the surface-currents caused by the winds and obliterating the main phenomena. In the southern hemisphere drift icebergs of 200, 300, and even more feet in height above the water are common; and if we take into consideration that their depth under the water must be six or seven times greater, we shall be able to understand that the movement of these ice-masses, which, moreover, are of colossal extent horizontally, must be the result of various forces working upon them. Under-currents, surface-currents, and prevailing winds, have to be considered in interpreting this phenomenon, according to the size and proportion of the mass presented; though the comparatively feeble surface-currents are of subordinate importance.

It would lead us too far here were we to attempt a thorough discussion of all the modifying causes and phenomena; it need only be mentioned that the water-masses of the Polar zone move, so to speak, to lower latitudes, as is sufficiently expressed in the so-called "Antarctic Drift." And by the south-east winds, which prevail in the southern summer, colossal masses of ice during that season push their way northwards, where they partly break up, but partly also are driven back by the north-west winds of autumn to the south. Although nothing certain can be said concerning their course towards the Pole, and only in particular circumstances is a south-easterly return movement established, yet it may in general be stated with regard to the masses which outlast the summer, that their northward and southward course may be explained by a periodical prevalence of the impulse from the surface or under-current. In winter, when the Antarctic drift-current, on account of the smaller differences of temperature and evaporation in lower latitudes, is less powerful, will the impulse, strengthened by the north-west winds, be directed towards the south-east or the south? Also, the movements of the ice during the other seasons can only be explained in this way; and on this account is the study of the various ice-charts of considerable advantage, especially the chart of the British Admiralty, on which are registered the results obtained from the commerce of the world.

The glacier ice-walls, of which we have accounts in several narratives of voyages, are, through the almost unbroken, and in winter specially rapid formation of ice, pushed continually farther and farther on into the sea, until at last, being insufficiently supported at the bottom, and subject to the buffetings of the waves, they break into pieces. Towards the end of the cold season this disintegration is still further assisted by the great differences of temperature betwixt air and water in high south latitudes, and with the setting in of September commences the journey of the masses of drift-ice from the south. It is in consequence of this that during the southern winter, scarcely any drift-ice is found on the great highways of the world's commerce. The result of a strict comparison is that the frequency of the occurrence of ice in June and December is in the proportion of 1 to 13. Further, that the prevalence of the drift-ice is greater in March and April than in September and October, is only a further proof of what has been stated, seeing that in the last-mentioned months the ice is still in the neighbourhood of the spot where it was formed, while in the former months it has either not yet been broken up, or has not got beyond the bounds of traffic on its return journey.

The masses of drift-ice do not everywhere move equally far to the north: in some places they are met with much nearer the equator than in others, as will be seen if we examine the region around the poles on the charts on which the position of the ice in the various months is laid down. The causes of this inequality are to be seen partly in the conditions of the current, but also in the difference of the distances from the pole of the places of formation of the various masses of ice: indeed, the greater this distance is so much farther to the north, *cæteris paribus*, will the ice be driven. We might now attempt to construct an average boundary line for the equatorial drift-ice, but from the variety of the boundaries and the lack of material for this purpose, its course would be very indefinite. We shall best arrive at useful results if we draw these boundaries in accordance with trustworthy notes, leaving meanwhile peculiar, and evidently altogether abnormal circum tances out of account. The ice is found in some pathways f commerce in much greater force than in others. According to the excellent map appended to Dr. Neumayer's amphlet, the drift-ice extends farthest into the South tlantic Ocean, where it makes its way to the 40th arallel of latitude, while in the Pacific Ocean its oundary coincides nearly with the 52nd parallel; in the ndian Ocean the limit lies between the 40th and 50th degree of latitude. Clearly the cause of the ice pushing ts way so far into the Atlantic Ocean is to be found in the fact that most of the icebergs there met with have their origin about Graham's Land and the South Shetlands lying far to the north, and, according to Towson's observations, they sail northward at a daily rate of ten miles in an easterly direction, when once they are exposed to the combined influence of the current and the westerly winds

It is easy to see that these attempts to fix an average boundary are fraught with difficulty, and therefore, also, with uncertainty, especially when it is taken into consideration that all parts of the ocean have not been equally explored—many, indeed, not at all, or only by single vessels. By an uncritical examination of all the collected facts relating to the subject, one might be led to very false conclusions. Therefore we ought to examine most narrowly any conclusions which may be drawn at first from the frequency of observation; but for so complicated an inquiry, the material within reach is by no means sufficient, and therefore we must seek for help from some other quarter. Those parts of the ocean are best compared which have been explored by a nearly equal number of ships. But this at present is the case only along the regular routes in the South Atlantic, the Indian, and the South Pacific Oceans, and therefore in these cases an immediate comparison is admissible. By such a comparison it is immediately perceived that in each of the oceans places are found which are almost free from drift-ice, and that throughout the whole year. A specially valuable means of determining such places as are free from ice, is the fact that, towards the equator, a gap in the ice-boundary is shown, through which a ship coming from lower latitudes may sail to the 60th degree south without having to pass through ice. These ice-free areas may be set down as follow:—

1. To the south-west of Cape Horn the boundary of the drift-ice reaches down to about 57° S. lat.
2. Between the 60th and 80th degree of E. long. the boundary is found in 61° S. lat.
3. Between 160° E. and 175° W. long. it has the same limit as in No. 2.

Of course, icebergs, which are influenced more by surface currents and the prevailing winds than by undercurrents, are occasionally found in these clear areas; especially is this the case in years which are exceptionally abundant in ice, as was the case in 1854-5.

Let us inquire, now, what kind of explanation can be given of these phenomena. These will naturally result, in some measure, from the considerations previously advanced: either the place of their origin must be placed far to the south of the places indicated, so that the icebergs have a long journey to make before reaching the highways of commerce; or the conditions of temperature within the region indicated are favourable to the melting and disintegration of the ice; or finally the direction of the current is such that the icebergs cannot reach the north. The winds, so far as the present question is concerned, can exercise no influence, for all round the Pole they are nearly the same for the same parallels. With regard to the currents which are open to direct observation, it is difficult to come to any fixed conclusions, for these observations refer only to the surface-currents, which are almost universally caused by the prevailing winds. Besides, the observations as to currents of the usual kind, for special purposes, are not to be relied on. That an interchange of water takes place, besides that in the way of the general drift, through powerful currents, we know through many instances which need scarcely be mentioned. The question is concerning the position of these currents, their exact course in the various oceans. But for this purpose the drift-ice offers a capital means of solution, while the warm currents born of the water from the equator, in virtue of their southerly direction against the advance of the ice, and in virtue of their temperature, must be highly unfavourable to the continuance of this. Further, it is evident that the interchange of water occurs along such routes as are determined by the rotation of the earth and the configuration of the lands and the bottom of the seas. These routes will lead to places lying as far as possible from the Pole. All three would agree in furnishing strong proofs that the area is free from ice, if only we assume that the warm waters of the equator proceed southwards towards the places referred to.

In reference to that principal current of the ocean which is always referred to in a theoretical view, it may be said that the fact has been established that the equatorial waters, in their powerful currents from east to west, are made to diverge by the east coast of the Continent, and turned towards the Poles in both hemispheres. We find the direction taken by the south in a current along the east coast of America, of Africa, and Australia, from which it then makes its way towards the south-east, and when not to be recognised as a surface-current, it will be found to have assumed the form of an under-current of much greater force. The warm South American current will probably split on the point of Graham Land; one part makes for Alexander Land, the other towards that part where Weddel, after he penetrated the pack-ice, reached water free of ice. The Australian branch tends towards Victoria in the south of New Zealand, and made it possible for Sir James Ross to reach the 78th degree of S. latitude, while the Mozambique or African current flows towards the Pole, beyond Kerguelen Land, between Termination and Kemp Lands. In the first two cases we have positive proof; while with respect to the last, the evidence for a correct judgment can only be obtained by researches in the high south. The direction of the axis of the ice-free area is, in agreement with the general direction of the current, according to the present condition of our knowledge, from north-west to south-east; at least this is true for the Indian and Pacific Oceans, while the wedge-shaped form of South America must tend to modify the general rule.

We know from several voyagers that a girdle of pack-ice lies around the Poles, whose position and strength are liable to change, though in a less degree than is the case with the drift-ice. Naturally in this case, the evidence necessary to a determination of the mean position is still more scarce, and still more data must be obtained to form a mean value, although the pack-ice girdle thus obtained can only have an ideal importance. If we follow the boundaries of this pack-ice girdle, we notice to the south of New Zealand a bend towards the south analogous to that of the drift-ice, only shifted in accordance with the general direction of the current; also on the west side of Graham Land this tendency of the ice to bend towards the south is noticed, for it is always influenced by the direction of the land. To the south of Kerguelen Land the pack will only be to the west of Termination Land, and, indeed, stretching in a direction which makes us suspect another bend towards the south.

We must yet mention a sort of product of the drift, of considerable importance in ascertaining the condition of the drift and the ocean-currents, viz., the seaweed. This is loosened from its position especially by drifting icebergs, and turned adrift to the play of the waves. This conglomeration of plants, which reaches a little above the surface, though the long fibres stretch deep down into the water, shows the currents very correctly, for it is as little influenced by the winds as a drifting bottle. The curve that limits the place of growth is confined, in the Atlantic and Indian Oceans, to about the 60th meridian of E. long., near to that of the drift-ice. In some places this also holds good for regions to the south of Australia and the south-east of New Zealand. At all events, it can thus be understood how those places which are free from drift-ice are also free from drift-weed, a point of some importance when we consider the fact that drift-weed is the attendant of icebergs. According to the Dutch voyagers, on the west of the meridian of Paul and Amsterdam are found weeds different from those on the east thereof, which points to a different current.

(*To be continued.*)

TYNDALL'S RESEARCHES ON RADIANT HEAT

Contributions to Molecular Physics in the Domain of Radiant Heat. By John Tyndall, LL.D., F.R.S. (Longmans, 1872.)

FORTY years ago our knowledge concerning the radiation and absorption of heat was very meagre. We believe that the earliest experiment in this direction is to be found in that wonderful book containing the "Essayes" of the Florentine Academicians. There we meet with the fact that the heat of the sun, converged by a mirror, can ignite a pastile placed within a Torricellian vacuum. A little later, in 1682, Mariotte communicated to the Paris Academy of Sciences that the heat of a common fire, made very sensible in the focus of a burning mirror, was entirely cut off by the interposition of a sheet of glass. The mirror in this case must have been of polished metal. These experiments were subsequently repeated and extended by Lambert, who, assigning the true cause, pointed out the necessity of employing metal, and not glass mirrors, in the reflection of heat from terrestrial sources. Lambert further showed that if the radiation from a clear fire were converged by a large glass lens, no heat was felt where*!* the brilliant focus was seen, whilst Hoffmann first collected the obscure heat of a stove to a focus by a metal mirror.

About a century ago Franklin made his experiments with bits of coloured cloth on snow, and found that, whereas colour strongly influenced the amount of solar heat absorbed, it made little or no difference on the emission from a lamp or candle. Beyond the foregoing information, we believe little more was known in this subject till, in 1777, Scheele published his famous treatise on "Air and Fire." But a great deal of ignorant talk, clothing itself beneath a barbarous jargon, was prevalent at that time. Putting much of this aside, Scheele asks himself the question, which he was unaware Lambert had already answered, whether it was really the heat, or only the light of a fire, that was reflected from a metal mirror; but first he seeks to know whether there are different kinds of heat. "There will be many," he remarks, "who will not hesitate to give an answer to my queries; for I am well acquainted with the vague phrases according to which everything is called Fire that hath a distant similarity to it. But I am of opinion," he naively adds, "it is best not to begin to read before one knows the elements of the alphabet, and to withhold an answer till one has reflected on the following experiments." Then comes a series of admirably simple experiments, pregnant with important results. As they deserve to be more widely known than they seem to be, the reader will pardon our quoting Scheele's own words at length. They are to be found in section 57 of his work already alluded to:—"From these experiments"—made in winter, before an open stove, and with only a candle, a concave mirror, and sheet of glass and metal, for apparatus—"it appears," says Scheele, "that the heat, mounting with the air in the stove, and passing through the chimney, is materially different from the heat passing through the door of the stove into the room. That the latter heat departs from the centre, where it is generated in straight lines, and is reflected from polished metals under an angle which is equal to that of incidence. That it unites not with air, nor can be diverted by a current of air, into a direction different from that which it originally had received. For that very reason, the vapours of the breath are visible in this great heat; for since air and heat are really united during summer, and warm air can dissolve more water than cold air, it likewise hence appears that this kind of heat is not united with air, nor has this kind of heat probably rarefied the air; and of consequence it becomes evident why it causes no tremulous motion in sunshine. You may, by means of a glass mirror, separate the light from the heat, when the heat remains in the glass, and the radiant light yields no heat. Hence it follows that the heat passing through the door of the stove, coincides, in some points, with the light, but is not yet quite become light, since it is not reflected in the same manner from a glass surface as from a metallic one—a remarkable circumstance. This heat is soon changed into the usual heat whenever it unites with a body, which may be observed in the glass, and in the metallic concave mirror blackened by soot, and in more instances. Represent to yourself," he concludes, "a little hillock of burning coals; in this case the heat darting from this hillock all around is that which may be reflected by a metallic polished plate; the on the contrary, which rises upwards, and may be driven by winds to and fro, unites with air. I will call the first kind, for distinction sake, *Radiant Heat*." Thus arose he term we still employ. The whole passage reads as if t were written almost at the present day; and the lucid style of the last sentence cannot fail to strike the reader. This is the more remarkable if we contrast it with the current ideas of the time, or even with Scheele's own description of the heat of contact; for a little further on he states, "This heat is a peculiar acid, which has admitted a certain quantity of phlogiston in its mixture."

Soon after this Pictet made his well-known experiments on the reflection of heat. In these he confirms the fact of the reflection and convergence of obscure rays, and discovers that the velocity of radiant heat is beyond the reach of experiment. To him is also due our first knowledge of the apparent reflection of cold, a fact explained some ten years later (1792) by Prevost, according to his famous theory of exchanges.

The experiments on radiation published in England at the close of the last and the early part of the present century, will be familiar to most of our readers. It will be remembered that Sir William Herschel established the refraction of heat, and the difference in the quality of solar and terrestrial heat; that he confirmed Leslie's experiments on the heating power of different parts of the solar spectrum, and first discovered that the maximum heat was beyond the visible red (experiments subsequently verified by Sir H. Englefield); that he also determined the transcalency of various kinds and colours of glass, both to white light and to the light of the spectrum.

Both Rumford's and Leslie's inquiries into the Nature and Propagation of Heat quickly added to this knowledge; to Leslie belonging the capital discovery of the reciprocity of radiation and absorption. The accounts in our modern text-books render a further allusion to these experiments unnecessary.

A quarter of a century now lapsed; the attention of the scientific world being diverted by the electro-chemical discoveries of that period. One of the products of the new activity thus aroused was the discovery of thermo-electricity by Prof. Seebeck in 1822. Some ten years afterwards, Nobili constructed the well-known thermo-electric pile. Associating this instrument with a galvanometer, Melloni at once turned Seebeck's discovery into a thermoscope of surpassing delicacy. The fruit of one man's work thus soon became the seed of new and more vigorous investigation. And so prolific was this seed in Melloni's hands, that the blackened face of a thermo-pile is at present considered the indispensable pre-requisite in every exploration in "the domain of radiant heat." For six years Melloni pushed on with his researches; determining the amount of heat transmitted through innumerable solids and liquids—their relative *diathermancy*, as he expressed it—and using these determinations to investigate the quality of heat emitted from various sources. But the discovery with which his name will always be associated is that each material possesses a selective absorption, a veritable heat-tint, to which he gave the name of *thermochrosis*; thus confirming and explaining a similar fact previously noticed by De La Roche. Hence it was that Melloni called the volume "La Thermochrose," in which he grouped together the investigations that he had published, in the "Annales de Chimie," and the *Comptes Rendus*, between the years 1833 and 1839. The appearance of these researches was characterised by M. Biot as "un nouveau champ de découvertes, que M. Melloni a exploité avec un sagacité une addresse et une patience inimaginables;" the subsequent verdict of physicists has not lessened this high opinion.

The interest awakened by Melloni's inquiries was no doubt the main cause of the rapid additions to our knowledge of the phenomena of radiation and absorption, that followed. Among others, Forbes, Dulong and Petit, De la Provostaye and Desains, Knoblauch, Jamin, Masson and Courtépée, Müller and Balfour Stewart, signalised themselves by the value of their investigations in this department of natural knowledge. But the whole of these inquiries were directed to the behaviour of solids or liquids, or the analysis of radiation itself. The influence of gases and vapours on radiant heat was not entertained. Melloni, indeed, thought such attenuated bodies could not come within the reach of experiment; for he had ascertained that a column of air some 20 ft. long exerted practically no absorption on the radiation from his source. Pouillet and Forbes, however, showed that the heat of the solar rays are largely absorbed by our atmosphere; and Franz believed (though erroneously) that he discovered a considerable absorption of heat by the air contained in a tube only 3 ft. long.

Briefly speaking, this was the state of our knowledge in this branch of Physics when Dr. Tyndall approached the subject in 1859. After having wrought for twelve years, Prof. Tyndall has now gathered into the volume before us the important results his unremitting labour has won. A summary of these results must be left to another article.

W. F. BARRETT

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

On the supposed new Marine Animal from Barraud's Inlet

As some interest seems to be excited as to the nature of the animal that forms the long calcareous axis that has been received from Barraud's Inlet, I forward you a copy of a short notice I read on the subject before the California Academy of Sciences, July 17, 1871. I also enclose a piece of the stem with some of the soft parts still adhering to it, as it is possible its examination by competent observers will determine if I correctly referred it to the sponges.

"An examination of the specimens received from Barraud's Inlet enables me to refer them to the Protozoa class, Spongidæ or sponges. Although apparently nothing but the calcareous stem has reached us, yet on some specimens I found one end of the stem covered with a horny substance, which, when moistened and examined under the microscope, presents the character of a true sponge, being formed of a tough sarcode arranged in the form of irregularly reticulated tubes, the sides of which are studded with minute pores. The arrangement of the sarcode round the axis is not circular, but has somewhat the appearance of a Maltese cross. The central axis is formed by calcified layers of a tough chitinous substance. In the specimens we have received the greatest thickness is about ⅜ of an inch, but the longitudinal fissures found in many of the stems would indicate that they had shrunk. They contain about 80 per cent. of carbonate of lime. At each end the stem is tapered off. The top terminates in a fine hair-like prolongation of uncalcified chitinous substance. The lower part of the stem, which in our specimens is the only part covered with sarcode, also tapers down to about the thickness of a straw, and here there is no calcified axis. A thin section of the stem in its thickest part showed that it had been formed in concentric layers which were perfectly circular and presented nothing corresponding to the stellate arrangement of the sarcode. These rings undoubtedly represent different phases in the life of the animal. I have counted as many as thirteen in one section, and should they indicate animal deposits, this would give us thirteen years as the time required for their formation, a period not too long when we consider the length (upwards of seven feet) which some of these stems have attained. Whether this specimen is new I am not prepared to state, and shall not therefore name it, although I believe it has not been before observed. Its generic relations will, I think, be with Hyalonema and Euplectella, both sponges of the Pacific." JAMES BLAKE

San Francisco, Oct. 27

Misleading Cyclopædias

CAN any of your readers inform me if there is such a thing as a good and honestly constructed cyclopædia—one that does not send you hunting for information from one volume to another, and refer you backwards and forwards to articles that do not exist?

I have been repeatedly annoyed by this kind of will-o'-the-wisp, but have to-day met with such an outrageous example of it, that, although it involves some trouble, I feel it to be a duty to make a public exposure of it in your columns.

Requiring some facts on unusual atmospheric refraction, I turned to "Refraction" in the "English Encyclopædia." This article referred me to "Mirage, Fata Morgana," &c., for information on this branch of the subject. Turning to "Mirage," I found not a word, but another reference to "Reflection and Refraction, Atmospheric, Extraordinary." Next I tried "Fata Morgana," again the same reference. Coming back to letter R, I found the article "Reflection and Refraction," but was here referred to "Light, Optics, Refraction, Refrangibility;" then to letter A, "Atmosphere, Atmospheric"—nothing on the subject. Letter E, "Extraordinary Refraction"—nothing but a reference back again to "Mirage!" "Light, Optics, and Refrangibility" contain nothing on the subject.

I was thus sent on a search through five volumes of the work, and made to hunt out nine distinct headings for what does not exist; and what makes the matter worse is, that the writer of the article "Refraction," at the end of the work, must have *known* that it did not exist when he referred back to "Mirage, Fata Morgana," &c., which words have not a word of information appended to them.

An alphabetical cyclopædia is so much the most convenient for reference, and might be such an invaluable addition to a library, that it is the more to be regretted that it should be brought into disrepute by the absence of all efficient editorial supervision.

A. R. WALLACE

Rainbows on Blue Sky

IN NATURE for Nov. 21 a correspondent asks for examples of bows seen on a cloudless background.

I have seen this phenomenon twice at least. In one instance I remember that the extremities of the bow were seen against cloud, while the central portion bridged a space of clear blue sky.

A more perfect example occurred on the 19th of February in the present year. The following is a *verbatim* extract from my notes of that day:—

"Peculiar rainbow at 11.50 A.M.; perfect (except quite near the extremities), fairly bright, but projected throughout its entire length against clear blue sky. No rain was falling at the time, nor was there any appearance of falling rain on the sky, but the character of the clouds and of the weather was consistent with the supposition of slight and partial showers."

The phenomenon, although rare, does not seem to call for any special explanation. In showery weather, especially with a low barometer, one may sometimes see rain falling from a mere shred of cloud, the sky round about being clear. In such a case it is evident that there may be places whence an observer would see a rainbow against blue sky. Even should there be no visible cloud from which the rain seems likely to have fallen, the same explanation will still serve, for the cloud may be too attenuated to be visible, or may indeed be actually exhausted, the rainbow being formed on its last drops.

It scarcely needs to be pointed out, that when a rainbow is seen, as it usually is, against a cloud, the presence of the cloud is accidental rather than essential, the bow being formed not on the cloud, but on the drops of falling rain, and those being generally much nearer to the observer than the cloud.

Clifton, Nov. 25 GEORGE F. BURDER

The Greenwich Date

I AM anxious to obtain the solution of a question which has for some time perplexed me, and which is rendered more pressing than formerly, now that telegraphic communication is established between England and Australia.

It appears that a telegram sent on October 21, 3h. 5m. mean astronomical time at Adelaide, was received on October 21, 21h. 40m. mean astronomical time at Greenwich. Now, to obtain the Greenwich date of its despatch, we apply the longitude in time, adding when the place is west of Greenwich, and subtracting when it is east. Adelaide is 9h. 35m. east of Greenwich, the date sought is October 20, 18h. 10m. But suppose a place 9h. 35m. west of Greenwich, then the date sought comes out October 21, 13h. 10m., that is to say, the result of the operations gives a difference in the day of the month at places where, in fact, the day of the month must actually be the same. The query then is—in what part of the globe, and in what meridian, does October 20 end, and October 21 begin?

Fleetwood Vicarage JAMES PEARSON

Ocean Meteorological Observations

I PRESUME that anyone looking at the chart on page 43 of this week's NATURE, or reflecting on the circumstances under which barometric observations at sea are ordinarily taken, will agree with me that it would be wiser to give only two places of decimals, and not indicate a degree of refinement which the observations do not warrant. This point being granted (and even if it is not I shall maintain the same line of argument), I submit that the writer of the article is in error in saying on page 44: "Range corrections for pressure and temperature over the region under discussion are not yet accurately enough known to justify the committee in 'correcting' the results on the large chart by hypothetical corrections."

The daily range of the barometer in the very square under notice was investigated under Admiral Fitzroy's direction, and the results were published so long ago as 1861, as the seventh number of Meteorological Papers, under the title of "Intertropical diurnal range tables of the barometer."

It is very strange if this publication is unknown both to the author of the work reviewed and to the reviewer, and yet it is so cognate to the subject in hand that there would surely have been some reference to it, had they been aware of what had already been done. G. J. SYMONS

Nov. 25

Earthquake

AN earthquake was felt at the Cavendish Bridge Brewery, near Derby, on November 13th, at 4h. 10m. P.M.

Mr. G. T. Eaton, who was in his greenhouse, says "the glass was very much shaken." Mrs. Sandford was considerably shaken by a vibratory motion of her chair. Mrs. Eaton's children, who were upstairs, were alarmed. The windows rattled, and the glasses danced on the tables. The sky was dark and threatening, with a slight fall of sleet and snow.

I have delayed sending a report until further evidence could be obtained. It is now certain that the shock extended through Shardlow; and the earthquake was also felt in the neighbourhood at Aston, Castle Donington, and more particularly at Chellaston.

E. J. LOWE

Highfield House, Nottingham, Nov. 24

The Birth of Chemistry

MR. RODWELL writes:—"The Greek name for tin, 'kassiteros' (*κασσιτέρος*), was perhaps derived from the Insulæ Cassiterides or Scilly Islands;" but he does not state how these islands came by such a high-sounding name.

I have heard that the root word is Sanscrit, and was known in India before the Phœnicians discovered Britain. A. H.

PHYSOSTIGMA AND ATROPIA[*]

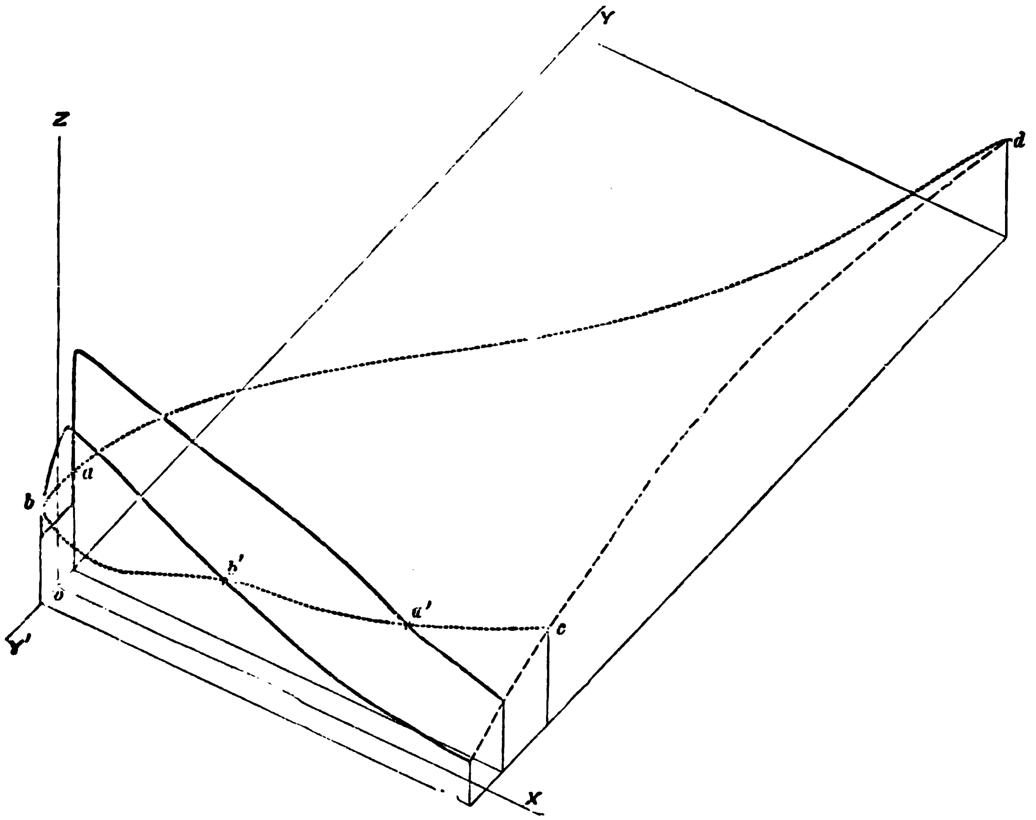
IN this remarkable memoir, Dr. Fraser has shown how problems in experimental therapeutics may be treated with a kind of exactness which has hitherto been confined to purely physical inquiries.

That an antagonism exists between the physiological action of atropia and that of the Calabar bean had been strongly indicated by Kleinwächter and by Bourneville.[†] Dr. Fraser has not only confirmed this, but has, by means of a series of nearly 500 experiments, traced the character and extent of this antagonism. As the object of this communication is not to give an account of the matter of Dr. Fraser's paper, but to explain shortly its method, we refer the reader interested in therapeutics to the paper itself for details.

The experiments were performed on rabbits, of as nearly as possible uniform weight (about 3 lbs.) and condition. The doses of the two poisons were administered in the form of aqueous solutions, by subcutaneous injection.

It will be at once seen that, if we assume all the rabbits to have been of the same size, age, and general condition,[*] there are three quantities by change of which the conditions of experiment may be varied. These are—(1) the dose of physostigma; (2) the dose of atropia; and (3) the interval of time between the administration of the two doses. In the tabular summary of experiments, Dr. Fraser has noted in each experiment the effect on the pupils, on the heart's action, on the respiration, on secretion and excretion, and on the action of the voluntary muscles. We shall, however, in this notice confine ourselves to the general result, viz., recovery or death.

After proving, by means of upwards of 50 experiments, that the administration of small quantities of sulphate of atropia enables an animal to recover after a dose of extract of Calabar bean that would otherwise have caused death, Dr. Fraser proceeds to trace, by means of three series of experiments, the nature and extent of this antagonising action.



It is scarcely necessary to state that this action is of a purely physiological character, the two drugs having no chemical action upon one another.

In describing these three series of experiments, we shall, for the sake of shortness, refer to the three variable quantities mentioned above as follows:—

x = The dose of sulphate of atropia measured in grains per 3 lbs. of rabbit.

z = The dose of extract of Calabar bean (or of sulphate of physostigma) in units of 1·2 grain of extract, or 0·12 grain of sulphate of physostigma, per 3 lbs. of rabbit.[†]

y = Interval of time in minutes between the administration of the two substances, taken positive when the atropia, negative when the physostigma is administered first.

In the first series, $y = 5$; in the second, $y = -5$; and in both x and z are varied, so as to obtain the limit which separates conditions leading to recovery from conditions leading to death.

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[*] "An Experimental Research on the Antagonism between the Actions of Physostigma and Atropia." By Thomas R. Fraser, M.D., Lecturer on Materia Medica and Therapeutics. Trans. R. S. E. xxvi. 129—713.

[†] Since the publication of Dr. Fraser's preliminary note, Bourneville has published a series of experiments satisfactorily demonstrating the existence of this antagonism.

[*] As a given dose of poison affects a small animal more than it does a larger one, the doses were, for the purposes of comparison, multiplied by the factor $\frac{3}{\text{weight of rabbit in pounds}}$; thus reducing them to the doses which would have produced the same effect on a rabbit weighing 3 lbs. This is almost certainly not a perfect mode of correcting for difference of weight; but as the correction is always small—the animals being selected of as near 3 lbs. weight as possible—it may be assumed to be practically sufficient.

[†] This unit was chosen by Dr. Fraser as being the minimum dose producing death when no atropia was administered.

In the third series, z is constant $= 1 \cdot 5$ (that is, a dose one-half greater than that which would produce death if no atropia were administered); and x and y are varied, so as to obtain sets of limiting conditions.

If the three variables, x, y, z, be expressed by means of a system of three rectangular co-ordinates, the conditions of each experiment will be represented by a point; and the points representing experiments resulting in recovery will be separated from those representing experiments resulting in death, by a surface passing through the points representing sets of limiting conditions.

The three series of experiments make us acquainted with three lines on this surface, viz., the intersections of the surface and the three planes, the equations of which are, $y = 5, y = -5$, and $z = 1 \cdot 5$.

Some further knowledge of the character of the surface may be obtained from a consideration of the general conditions. Thus, when no atropia is administered, the limiting value of z is obviously the minimum fatal dose of physostigma; that is, $x = 0, z = 1$. In the same way, when $z = 0$, $x =$ the minimum fatal dose of sulphate of atropia for a 3 lb. rabbit, = about 21 grains, or $z = 0$, $x = 21$.

Again, there must be a limiting value of y; that is, an interval of time so great as to prevent the two poisons acting simultaneously, the animal having either died or completely recovered from the effects of the first substance before the time for the administration of the second has arrived. When y exceeds this value, the surface must consist of two planes, the equations of which are, $x = 21$ and $z = 1$.

This limiting value is of course not necessarily the same on the positive and on the negative side; and, in fact, Dr. Fraser's experiments show that it lies very much nearer to the plane $y = 0$ on the negative than on the positive side.

Beyond these values of y, the surface consists of two plane sheets meeting in a rectangular edge. Each of these sheets separates points representing conditions under which recovery takes place from conditions leading to death; but in the case of the sheet $z = 1$ the space on the one side represents recovery and on the other side death caused by *physostigma*; while in the case of the sheet $x = 21$ the space on the one side represents recovery and on the other side death caused by *atropia*.

If we look closely at the portion of the surface lying between these limiting values of y, we shall see that here, also, the surface consists of two sheets; in the one $\frac{dz}{dx}$ is positive, in the other negative; in the one a small increase of the dose of atropia tends to recovery, in the other to death; the one runs continuously into the plane $z = 1$, the other into the plane $x = 21$. These two sheets meet in an edge, which is particularly well seen in the sections by the planes $y = 5$ and $y = -5$. (The various lines above mentioned are represented, in orthogonal projections, in the accompanying woodcut.) There can be no doubt that this edge is continuous with the rectangular edges between the plane sheets before mentioned. The conditions represented by points situated on this edge are such that increase of the dose of either substance will produce a fatal result, and that either increase or diminution of the dose of atropia will produce a fatal result.

This paper appears to us specially worthy of attentive consideration, as the first systematic investigation of the combined action of two poisons, and also on account of the method employed in arranging the results of the investigation; a method of which we have given a sketch in this notice, and which seems certain to lead to increased accuracy of observation, by giving the means of greater definiteness in the statement and classification of results.

NOTES

THE Royal Commission on Scientific Instruction and the Advancement of Science have this week examined the Marquis of Salisbury and Sir Stafford Northcote.

THE Anniversary Meeting of the Royal Society will be held on Saturday next.

AT the meeting of the Royal Geographical Society held on Monday night, the President stated that Mr. Young, the firm friend of Dr. Livingstone, to whom we recently referred, had sent him a cheque for 2,000*l*. to help to defray the expenses of the Livingstone Congo Expedition, which, under the command of Lieut. Grundy, who is well acquainted with the West Coast of Africa, is expected to start for Africa during the course of the present week. Government, we are glad to say, has given this expedition all the assistance in its power, furnishing letters to its officers on the West Coast of Africa, for the purpose of procuring the expedition all possible facilities. The War Office has made a present to the members of the expedition of the necessary arms, while the African Steamship Company has very kindly given to the officers passages at half the usual price. Lieut. Grundy thus starts under very favourable auspices. Sir Bartle Frere, the leader of the anti-slavery expedition from the opposite coast, left England last Thursday, and is expected to reach Brindisi in the course of a few days, where he will be joined by Lieut. Cameron and his party, who are just about to leave England. The party will then proceed, on board the *Enchantress*, through the canal to Zanzibar, where Sir Bartle Frere will give his final instructions to those gentlemen who are to form the expedition. The president, Sir Henry Rawlinson, places every confidence in Lieut. Cameron, and in the zeal of the officers by whom he is accompanied; he is determined to avail himself of every possible opening to penetrate into the interior of Africa, for his own credit, for the advantage of science, and for the purpose of aiding and relieving Livingstone.

THE Khedive of Egypt is also about to send a force comprising 5,000 men, under Purdy Bey (one of his American officers) to Zanzibar in transports. The ostensible object of the expedition is to go into the country which it is supposed that Livingstone may be exploring, and to co-operate with him, if it be agreeable to him; but if he declines assistance, the expedition would undertake on its own account a search for the sources of the Nile, where, if discovered, the Egyptian flag would be planted.

THE scientific news which comes to us every other week from France is refreshing and hopeful. There has been founded at Bordeaux a scientific association embracing the whole of the south-west of France, especially the Gironde and neighbouring departments. It is connected with the French Scientific Association, preserving, however, its autonomy and special organisation, its title being "Groupe Girondin" of the French Association for the Advancement of Science. Its seat is at Bordeaux, and, for scientific purposes, it is divided into four sections, each section corresponding to one or more sections of the French Association. They are—1. Section of the Mathematical Sciences; 2. Physical and Natural Sciences; 3. Medical Sciences; 4. Moral and Social Sciences. Each section meets monthly at Bordeaux, the first in the first week of the month, the second in the second week, and so on. The work of the sections consists of lectures, exhibitions, and scientific discussions on the subjects proper to each section. This provincial association intends to publish at intervals such papers as are likely to be of general interest, to encourage scientific researches by pecuniary help; and to give prizes for the best memoirs on subjects to be proposed by it. Most heartily do we wish the society success.

SIR JOHN BOWRING, whose death took place on Saturday last, at the age of eighty, was better known to the public in the rld of politics than of science. In the latter, however, he ed a by no means unimportant position, as one of the most enuous advocates of an international decimal system of weights d measures, and as an old and and very regular attender of the etings of the British Association, where he devoted himself iefly to the Section of Economical Science.

IT is expected that Sir William Jenner will be the President the Pathological Society for the ensuing year.

THE Master and Fellows of Gonville and Caius College, Camidge, have recently determined to appoint a prælector in emistry to superintend the laboratory, and to have charge of e chemical studies of the students at the college. The stipend ill be 200*l*. a year, and the prælector will have the status of a ellow of the college. The election will take place about the iddle of next month.

AT a meeting of the Royal Society of Arts and Sciences of auritius, held on September 25, it was resolved that, like other cientific societies which have met in London the Society should onvey to Dr. Hooker the feelings of regret and sympathy with hich they have learned that differences had arisen between him s Director of the Botanical Gardens at Kew, and the First Commissioner of Public Works. It is the earnest hope of the Royal ociety that Dr. Hooker, whom the Society has the honour to nclude among its members, as it did for many years his illustrious father, will succeed in maintaining himself with honour in he Directorship to which he has been raised by his merit and xtensive knowledge, and which he has held with such distinction to himself and advantage to the public.

THE Civil Service Commissioners have announced that on December 31 they will hold an open competitive examination for the appointment of clerk to the Curator of Kew Gardens. Candidates must be between the ages of twenty and thirty, and must be familiar with the routine duties of the garden, and competent to direct the foremen in matters relating to their accounts. On the same day the Civil Service Commissioners will hold an examination for the appointment of second assistant in the Herbarium at Kew, for which persons between eighteen and thirty who are skilled in practical botany will be eligible to compete. In each case the Commissioners will apply to Dr. Hooker for a report on the technical qualifications of the candidates.

THE *Times of India* speaks of a rumour that the Government intends to abolish the Deccan College, or rather to amalgamate it with Elphinstone College. By this plan, Government pretends to think, higher education would be advanced in India. But the *Mora Prakash*, an Indian paper quoted by the *Times of India*, says the end would be much more effectually accomplished by appointing to both colleges a greater number and more efficient teachers than has generally been the case hitherto. For the two colleges there are thirteen professors; but Elphinstone College is allowed two Professors of Mathematics, while the Deccan College has none, and no Professors of History and Political Economy. We hope the threat is a mere bait to ascertain public opinion. Intelligent public opinion, we believe, would certainly condemn the step, and urge Government to make the teaching staff more numerous and effective.

A CORRESPONDENT writes to the *Athenæum* :—"The question of admission of women to medical degrees in Edinburgh University has been rather unexpectedly solved, at least for the present. Miss Jex Blake, a foremost champion of the movement, has actually been plucked in her examinations, and sent back to complete her scientific studies." Many people will be quite unable to see that this by no means surprising accident affects in any way the great question of the unrestricted admission of women to the privileges of university teaching.

WE are delighted to notice that the Liverpool *Daily Post* has for some time past been devoting about a column to science, giving, besides notifications of the meetings of the numerous learned societies in and around Liverpool, a selection of scientific notes from this and other journals. We cannot give too great praise for the step taken by this paper in the right direction, and we only wish that all other provincial, as well as metropolitan, papers would follow the example, and give the latest news of a power which a distinguished Frenchman recently declared would soon become the ruler of the world.

IN a recent speech by the Rev. Mr. Tuckwell, he made some pertinent remarks on the Future of University Local Examinations. After referring with all due praise to the "Regulations of Oxford and Cambridge," he was yet compelled to say that without most serious modifications, the machinery of these examinations will be insufficient to meet the demand of the time which is surely coming, when compulsory universal public examinations will be imposed upon all the English schools. They show deficiency in four vital points. "They are administered by the older universities exclusively; but within the last forty years a race of teachers has grown up, who owe to an institution young yet already famous those feelings of loyalty and affection which some of us associate with the more venerable names of Oxford and Cambridge; and these men will give in their adhesion to no University examining body in which the London University remains unrepresented. They are costly to individual candidates: yet surely, from the wealth of the Universities and from the large educational endowments now in the hands of the School Commissioners, it would be possible to find funds for the extinction or the diminution of this tax. They unwisely limit subjects. Five optional subjects are permitted to junior candidates, of which Scripture must be one. They take up Scripture then because they must; Greek, Latin, and Mathematics, because these are supposed to gain higher marks than anything else, and are the leading subjects in their school work; there remains the choice between modern languages and science; nine boys out of ten, under the pressure of parents or teachers, take up French, and thus a severe though unintended blow is dealt at physical science. Lastly, they are in no sense compulsory; and the temptation to an unscrupulous master to pick out a clever boy, and work him exclusively for high distinction, while he starves the rank and file, is too obvious to need further notice. When these four blots are wiped away; when the three Universities combine to hold one great examination once a year; when the fees are lessened or abolished; when free trade in subjects is set up; and when all boys in every school above a certain age are compelled to undergo the ordeal; then, indeed, and not till then, we shall see such a system of examinations, so perfect in theory, so priceless in its effect upon school-teaching, as for the present we must be contented to behold only in our dreams."

AN astronomical and meteorological observatory is about to be erected by the Russian Government at Tashkend, in Central Asia, about 100 miles north-west of Khokan.

THE fossil man discovered at Mentone is at present being exhibited at the Jardin des Plantes, Paris.

MR. W. F. DENNING, of Bristol, noticed on Saturday evening last a meteor of considerable brilliancy. It radiated from a place at the extreme north-west part of Andromeda, passing through the sword-hand of Perseus, and onwards through Camelopardalus, becoming extinct, as if burnt out, on reaching the head of Ursa Major. In its flight the meteor faded several times and revived again with great rapidity. It did not leave any train of light marking the path it had traversed, though it emitted a spark in its course. In reference to its brightness Mr. Denning says that it excelled Venus when at her maximum degree of brilliancy.

PROF. PIAZZI SMYTH, writing to the *Athenæum*, says that the finest specimen of one of the "casing stones" of the Great

Pyramid known at present to exist either in Europe, or even in Egypt, was received last week in Edinburgh from Mr. Waynman Dixon, a young engineer who has recently completed an iron bridge across the Nile between Cairo and Jeezeh. The specimen possesses, Prof. Smyth says, in a more or less injured condition, five of the anciently-worked sides of the block, including the upper and lower horizontal surfaces, together with the levelled surface between. It was the exact angle of this levelled slope which led the late Mr. John Taylor to what Prof. Smyth calls "the immortal archæological truth, that the shape of the entire monument was carefully so adjusted and exactly fashioned in its own day to precisely such a figure that it does set forth the value of the mathematical term π, or does, vulgarly, demonstrate in the right way the true and practical squaring of the circle." Whether this be the case or no, Prof. Smyth declares that the length of the front foot of the stone, or that line or edge from which the angular π slope of the whole stone commences to rise, measures, "within the limit of mensuration error now unavoidable, the number of just twenty-five pyramid inches, neither less nor more. And twenty-five pyramid inches have been shown to be the ten-millionth part of the length of the earth's semi-axis of rotation." Prof. Smyth is very severe on the Egyptologists of the British Museum for the manner in which they conduct their department.

THE *Athenæum* informs us that the first volume of a Russian translation of Mr. E. B. Tylor's "Primitive Culture" has appeared at St. Petersburg. The German version of the same work is also announced as being just about to appear; and a French translation of Mr. Tylor's "Early History of Mankind," with notes by the translator, M. Emile Cartailhac, and by M. Quatrefages, is stated to be in preparation.

CONCLUSIVE proof has been obtained by a correspondent to *Notes and Queries*, that the treatise "On Probability" is not by De Morgan, but by the late Sir John William Lubbock. On inquiry at the Museum, the little slip of paper containing the original title was produced, and which gives the authorship to Sir J. W. Lubbock. On the back of the slip was inscribed the note—"Information from Prof. De Morgan, Dec. 62."

WE see from the *Times* of India, that Mr. Griffiths, of the Bombay School of Art, with a few of his students, intends, about the end of December, to go to the remarkable caves of Elephanta, to copy the very beautiful painted decorations which still cling to the walls, in spite of damp, neglect, bats, and the relentless teeth of time. These caves are on a small island in the harbour of Bombay, about seven miles S.W. of the city, and contain some very interesting Indian antiquities. They get their name from the gigantic figure of an elephant which formerly stood near the shore, but has now fallen to decay.

A CORRESPONDENT, Mr. W. B. Shorte, writes under date Nov. 4, from on board the steamship *Tanjore*, Bombay, giving us a few notes on the occultation of Venus, which he witnessed on the evening of Nov. 5. A small telescope with a magnifying power of about 100, and a pair of good binoculars, were the instruments employed. The planet shone with such lustre that it was clearly seen by the naked eye even before sunset, and after sunset appeared for some time as if resting on the upper part of the dark limb of the moon. In a few minutes a very gradual diminution of the planet's light was noticed, and as the occultation proceeded a singular phenomenon was observed, namely, the apparent position of Venus within the moon's circumference, the planet actually appearing for some time as if situated *upon* the disc of the satellite, though much diminished in size, and shining as a minute point of light. This continued until the moment of complete occultation, the Bombay time of which was 5h. 46m. 47s. The re-appearance on the illuminated edge occurred at 6h. 26m. 32s., so that the planet was invisible for 39m. 46s.

THE ORGANISATION OF ACADEMICAL STUDY IN ENGLAND

IN connection with the question of the best application of the endowments of Oxford and Cambridge, a public meeting was held at the Freemason's Tavern, on Saturday Nov. 16 by members of the Universities and others interested in the promotion of mature study and scientific research in England. The meeting was called in response to a preliminary resolution to the effect that "the chief end to be kept in view in any redistribution of the revenues of Oxford and Cambridge is the adequate maintenance of mature study and scientific research, as well for their own sakes as with the view of bringing the highest education within reach of all who are desirous to profit by it."

The Rev. Mark Pattison occupied the chair. He explained that gentlemen present were not the representatives of any political party or political movement, but were there simply for an academical purpose. Neither were they to be considered as having met to take an initiative: the initiative had already been taken by Mr. Gladstone in appointing a commission to inquire into the revenues of the colleges and universities. They were only there to discuss the direction which, in their opinion, ought to be taken by any reform, initiated, not by themselves, but by other people.

Professor Rolleston, who was the first speaker, commenced by remarking that until the end of the last century, it would be admitted that the Universities were neither seats of learning nor seats of teaching. The first thing that was done was to make them seats of examination; and, as far as that is concerned, they work tolerably well at this moment. The great danger is that they should be made simply into that utilitarian sort of machine—a machine for examining and a machine for teaching. The speaker by no means wished that their capabilities in the way of examining and that kind of work should be curtailed. Still he thought it of very vital consequence, in this somewhat utilitarian age, to make the Universities into places where original research, and where the production of fresh facts and means of knowledge, instead of the mere communication and reproduction of it, should be recognised. One result of our present examination system is that men who, as grown men and during the whole of their university career, are subjected to the ordeal of examination *in futuro*, do not look at what they have under study as so much truth, but look upon it as something to be reproduced on paper, and to further their designs on Fellowships and Scholarships, and other pecuniary rewards. Now when a man is kept for something like twenty-three or twenty-four years of his life under that sort of training, he gets apt to look at all work whatever of the intellectual kind, from the point of view of the examination merely. Men get demoralised by the process. They do not look at the truth for itself. They have no notion of shovelling forward the elements of knowledge into some area into which nothing has been before. That is entirely a new vein to them: and he thought one of the first things requisite was that examinations should be considered rather more the work of boys, and of people just emerging out of boyhood, than that they should be prolonged into a sort of struggle for men who have got to man's estate. We have then to consider:—how is it possible for us to encourage that which we feel is an advantage of a greater kind, although it is one which can only be shared by a larger number?—How is it possible to encourage original research without sacrificing soundness of learning in the many? How can we encourage the few to research without at the same time sacrificing the great advantages which we do get for the whole public, by passing a great number of mediocre men through the mill which does make them useful machines for doing work in this country of ours? There is a very serious objection which may be urged:—"But how do you propose to encourage original research? Original research is a work of genius—you cannot fetter genius by law—you cannot tie a man who has this gift of original research by rules and laws. You cannot give him definite duties to perform, within a definite time; and then you are in this dilemma:—a man has nothing given him to do—will he not then do nothing?" That is a very common saying among people who have got effectually case-hardened by looking at things in a schoolmaster's point of view. A man who has nothing to do, they tell you, will do nothing. Now he believed by using the system of examination judiciously, by rewarding people for what they do and show under that particular ordeal, and then by giving them something or another which does keep em, so to speak, from beggary for the time being, it is possble then, by a well-adjusted system, to keep their minds open original research. But we know that funds must be found r it. A man cannot prosecute research unless he has got mething to find him bread for the passing moment. Although e thought we should be entirely wanting in our duties if we id aside the examination system, which has rescued the uni-ersities from the slough of idleness in which they were eighty r ninety years ago, yet, he said, we neglect our duty even more y neglecting the encouragement of men who have the capacity or original investigation and research. Again, a man who has ot some notion of what original research means, is not fit to be teacher at all. He would go even further, and say, if a man has he gift of original research, even if he entirely lack the power of communicating, and, what is another thing, the taste for communicating knowledge, he ought to have a place found for him. A man of that kind is like a light shining all around; setting by his example and his work a higher tone to society, a man who has the power of going into some new sphere. so that he may say to those whom he is teaching:—We are the first who ever burst into that silent sea.

Dr. Carpenter then spoke of the different system pursued by the German universities to that which prevails in our own.

Dr. Burdon Sanderson continued on the desirableness of fostering at the universities a class of what in Germany is called the *Gelehrter*, that is, said Dr. Sanderson, a man who not only possesses as adequate a knowledge as other men do of subjects in general, but has made a perfect study of some particular subject. The speaker then dwelt on the study of physical science, and of physiology in particular, as it should be conceived at an university.

The resolution "That to have a class of men whose lives are devoted to research is a national object" was then carried.

Sir Benjamin Brodie said that he had the strongest opinion that when the report of Mr. Gladstone's commission is published, and the true revenues of the colleges of Oxford are made known to the House of Commons and the world, the greatest surprise, and he might also say, the greatest indignation will prevail. He admitted fully that a great amount of good educational work is done by the Universities, but certainly thought that the work is totally disproportionate in every way to the machinery which exists for its performance, and it is idle and useless to say that we want an expensive collegiate system—a system of colleges manipulating actual revenues of thousands of pounds a year for the purpose of educating, however admirably, 2,000 students who, we may also say, absolutely pay for their education besides. When those statements are made, as they will be made, as to the property of the Universities and the Colleges, there will be the greatest danger that we may have a reform which perhaps none of us wish for—a reform which may be no improvement at all, but which may simply consist in the alienation from the purposes of knowledge of these great funds. Now with regard to the promotion of knowledge in various branches, this great object was entirely lost sight of by the Executive Commission in 1854. He believed that most persons in Oxford who are interested in real education, are not very well satisfied with the fruits of this Commission. The few things that they did in regard to the promotion of knowledge were done partly with that view, and partly under the pretext of reviving old foundations, such as the Linnæan professorship at Merton College, and four professorships at Magdalen College, and two or three other small institutions which the University had long ago buried under ground. The Commission dug these up, and therefore so far did something for the promotion of science. And indeed it is impossible, unless you absolutely destroy Oxford and Cambridge, to get rid of every record of the idea that those universities are founded for the promotion, and not solely for the diffusion, of knowledge; for that idea really runs through the whole university system. The great libraries of Oxford and Cambridge, and also the great collegiate foundations, bear witness to it. Now we wish to take up this thread where our predecessors dropped it, namely, this idea that the universities are institutions, not only for diffusing knowledge and education, but for absolutely promoting knowledge and investigation. However, a much more important object than that is the real welfare of the nation, as that welfare of the nation may be promoted by the growth of science and knowledge. With regard to scientific research, men are really hindered from investigation on all sides from the want of means of subsistence, and means of work. Certain aids are afforded to the investigators of science by existing institutions, by the Learned Societies, of England and the Continent; and we have also two or three national institutions which certainly on such an occasion as the present ought by no means to be forgotten, because we shall be told that this is not an object for the nation to care for. One of those institutions is the British Museum, which really exists solely for the purpose of preserving knowledge. Another institution is the Royal Observatory at Greenwich. We have again private foundations: the Meteorological Observatory at Kew; the Radcliffe Observatory at Oxford, and the like. All those institutions are founded, not in the least with regard to education alone, but for the purpose of promoting the growth of knowledge. He thought it really very little use for us to be too indefinite; and that, if we wish to produce any result, we must have some definite plan and programme. His own idea was tha it would be very desirable to found in the universities of Oxfordt and Cambridge certain specific institutions for the promulgation of scientific research; using the term scientific research in its widest sense, and include in it all knowledge which is capable of being made the subject of research; but certainly specific institutions should be founded for this object. It will not do to trust these great institutions to the growth of mere ordinary professorships, but he would certainly like to see certain specific institutions devoted to this object, which should represent the various great departments of human knowledge. Those institutions to be connected with professors specially selected for the objects which they have to fulfil, and where the professors would be provided with assistance and apparatus, and every means and appliance which could really be valuable and useful to them for the purposes of research; and he did not think that much less, or anything less, than this, would fulfil the object which we desire.

The Chairman moved, as the next resolution, "That it is desirable, in the interest of national progress and education, that professorships and special institutions shall be founded in the universities for the promotion of scientific research."

Professor Seeley spoke on the question of prize fellowships. He said the speeches to which he had had the pleasure of listening had brought the question of University Reform to a focus. He anticipated that this meeting, particularly if the movement were followed out further, would convey to the English mind an idea which it had perhaps no very great natural capacity for conceiving. The preceding speakers, said the Professor, have introduced to the Englishman to-night a character for whom we have found it difficult to find a name, because there is no name for him in the English language, and we have been obliged to call him in the German *Gelehrter*, and in French we call him a *savant*, but there is no English name for him. He is a person who is engaged in mature study, and who lives by his study; and we have made it plain that our object in University Reform is one definite thing; and that is to find for this person at the same time as we find him a name, a career. But we shall be met by an assertion that he already has a career in England, and he has also a name—that he is, in fact, the Fellow of a College. He wished to say a word or two first about this Fellow of a College, and about certain popular reasons for which it is supposed to be desirable always to have such persons. If you were to ask most English people about the English universities, they would say that the most glorious feature about them is just this—that a young man may go up, from any part of the country, without a penny in his pocket, and may get 300*l*. a-year given him for life; and to take away that, is simply to take away the scholastic glory of England, and whatever makes its universities superior to the beggarly universities of the Continent. To give a young man 300*l*. a-year, they think, is a thing which explains itself; but if you come to examine their meaning, you will hardly question that they are looking at the matter as a question of charity; that they want the young man to receive so much to do him good, and to give him a start in life.

He would, however, remark that he thought the objects of charity should be those who stand in need of it, and are not likely to be able to help themselves. But we carefully select young men in the vigour of life; and, not only that, but young men who have shown themselves to be possessed of more than ordinary abilities, that is to say, just the very young men who can get on in life without any such help. He recommended, if these institutions are retained, simply on the ground of charity, that these fellowships should be given to men carefully selected, whose abilities are less than those of others. Again, it is said, how excellent a thing it is that a young man going to the bar, in his first year of brieflessness, should have his fellowship to fall back upon. That is partly the same object of charity; but mixed up with it is another notion, that it is a good thing for the bar that in this way men of high education are brought into it. That is a very important question indeed, but he could not say that it is a question which we of the universities are called upon to discuss. There are other institutions which have charge of the interests of the bar—let them consider it. We have in London several great Inns of Court; and it is often said that they have funds. If it be so, and if it be desirable, by means of fellowships, to procure men of high education to enter the profession of the law, let them establish fellowships themselves for that purpose. That is a very simple course. But now comes the question which this resolution deals with. Is this fellow of a college, of whom we have been speaking, a person of mature study, a person who devotes his life to advancing the bounds of knowledge? Of course it is quite possible to mention the names of distinguished men, who have risen to distinction in their particular branches as fellows. But the question for us is, are fellows of a college, as a rule, men who are preparing themselves for that career,—is their life devoted to study and to knowledge—are they persons who are either enlarging the bounds of knowledge, or are on the way to enlarging them? He answered, confidently, they are not the class of men. He did not charge them with being a class of men with whom any fault whatever can be found. They are not what we are told they used to be many years ago. It would not be possible, perhaps, to find instances of the torpid, vacant lives which used to be led under the protection of a fellowship. They occupy themselves now in some way. They supply the scholastic world, they supply the clerical world, sometimes they supply the bar, they conduct a great many examinations in the country, and they do a great deal of work which is very valuable; but mature study is a work which they do not, as a rule, engage in, only with some exceptions here and there. The Professor went on to say that fellows were neither chosen by the right kind of electing body, nor according to the right method, for the end of furthering mature research. He criticised the existing terms of the tenure of fellowships, as well as the existing system of examination at the universities.

The Chairman then put the resolution: "That the present mode of awarding fellowships as prizes has been found unsuccessful as a means of promoting mature study and original research, and that it is therefore desirable that it should be discontinued," which was carried.

The Chairman then said that the subject of the professoriate is of course a very wide subject, and it is impossible to do more than just indicate the position which that question holds in our scheme. It is desirable that we should make it clearly understood that we are not aiming a blow at what is called the educational efficiency of the place. The question of the professoriate is one which was first mooted twenty years ago as the question of the professoriate *v.* the tutoriate, and it was regarded as a revolution in the educational institutes of the University. The question which we are now raising of converting the University into a centre of mature study was not then raised. The question of University reform turned entirely upon the educational question of professors *v.* tutors. What the Executive Commission of 1854 did was not to substitute professors for tutors in any great measure in the educational system of the University. The storm that had been raised by the mere sound of the word "professor" was so great that they were daunted, and did not dare to propose any large creation of the professoriate. Things are entirely changed now, and even if we confine ourselves only to educational requirements, we have not that battle to fight. But we have the situation which the Commissioners of 1854 created for us, and that situation is this. They raised a certain number of the then existing professoriates, and added to them a few others; and so called into existence a body of professors, many of whom have been extremely valuable and influential members of the University. But the situation of a professor in the University at present, or at any rate of the philosophical professors, is that of persons who are entirely outside the working of the system. For instance a very eminent professor once advertised a course of lectures on accents simply. This course of lectures he had prepared not only with very great pains, but he had for years investigated the subject of the origin and growth of the accentuation of language, in a way in which it had never been done before. His work was an original work. He had collected all the special programmes that bore on the subject, and he had constructed a history of language accentuation. He advertised this course, and proceeded to give it. At the first lecture the room was full; but when they found that this was an original philological investigation, and not a lecture as to the rules for accenting the perfect participle of the Greek verb, in order that they might use it in Moderations, they immediately fell off, and left it. The consequence is that the professors are not at all working now as a portion of the system. Now if we say that we want to set up more of these professors, University men will say, "Professorships are doing no good as they are at present. We are doing the work. It is we, the tutors, who are doing the work of the place, and you professors are simply ornamental." This is the result of the way in which the Commission of 1854 set about its work. They were told that the great evil of the University at that time was that the colleges had absorbed the University, and the first thing that a reform of the University should aim at was the reconstituting the University as against the colleges. Now, it is very important for us to let our attitude be understood to be quite different. We do not want, as the phrase is, to rob the colleges to make the University rich. The antithesis between colleges and university is *nil*, for our purpose. We do not intend to perpetuate the mistake which the Commissioners of 1854 did, and to take away a few thousand pounds from the colleges, make it over to the universities, and leave the colleges as they are. The speaker then went on to specify the diversions of college revenues effected by the Commissioners of 1854 by the endowment of professorships, and said that was not the kind of precedent which the present meeting was anxious to see followed. We are agreed (he continued) in desiring the creation of a body of resident students and teachers—real students and real teachers—and the attitude we shall take will be to say, "We will leave the colleges exactly where they are. We do not intend to rob the colleges and give the proceeds over to the University, but we will gradually convert them into what we wish to see them." The supposed antithesis between professor and tutor should be sunk entirely, in our point of view, and the whole body of resident graduates should be brought into one homogeneous association of teachers all working together—these teachers naturally being of different ages, and consequently of different attainments. We would begin, as they do in Germany, with the *privat docent*. It has been very well said that the *privat-docent* is the order upon which the principle of German universities principally rests. The eminent professors of whom we hear are not the actual working men of the place, but they are the men who have gone through the ordeal of working men as *privat docent*. They have been trained to that European celebrity under which we learn their names, but the *privat docent* are the working men of the place. Now, instead of putting the tutors into an attitude of hostility to the professors, as is the case at present, they might be reconciled to the professors by making them also professors, but making them of a lower grade in the teaching system. Of course there are various steps through which a successful teacher should have opportunities of working himself up until he can hope to attain the highest eminence that the University can afford him. Again (remarked the speaker) we must not endeavour directly to oppose the present examination system, however much we may be convinced of its effect, as actually carried out, in sacrificing literary and scientific ability. We must endeavour, as far as we can, to enfilter our system into the examination system; and for this reason we must not talk about professors who can be planted there to pursue their original research only, and make that our single object. We must take up the whole institution of teaching in the universities, and we must endeavour to impress upon the teaching the fact which has already been dwelt upon, namely, that there can be no healthy intellectual training unless the man who conducts it is a person who is himself capable of, and has the opportunity of engaging in, original research. That is the strong point; but we must not set ourselves to go and pull down the present system of examination directly. Another notion of university reform which we shall have to meet is the notion of transplanting a certain portion of the university revenues into the manufacturing and commercial centres of the population. That is an idea which, to those who attend to what one sees in the papers on the progress of opinion on the subject of the universities, has evidently taken deep root, and which more or less runs counter to our object—not altogether, but more or less. But that idea has taken such deep root, that it is doubtful whether, if we were to try, we could prevent something of that sort being done. If these persons who are sent over to Manchester and Liverpool are entirely under our direction, and are made mere persons who go and deliver an evening lecture for the amuse-ent of the fashionables in Manchester, then it would be very esirable if something like a connection between the universities nd the centres of population could be opened. One great complaint is, that the manufacturing and commercial interests have utgrown us; that they no longer regard us; that they do not hink we have got anything worth having; and of course it would e very desirable to reconquer that class of society, and bring hem back; and this tendency in the public mind, to dispose of portion of the University money, in sending it down to these laces, might be directed in such a way as to regain the possessors f wealth for us.

The Chairman put the resolution--"That a sufficient and roperly organised body of resident teachers of various grades hould be provided from the Fellowship Fund," which was also arried.

After one or two more speeches, it was resolved to hold another meeting in January to continue the discussion. The persons present agreed to form themselves, together with others signing the resolution, into a Society for the Organisation of Academical Study. A provisional committee was elected, and the meeting adjourned.

SOCIETIES AND ACADEMIES

London

Royal Society, Nov. 21.—"On the Mechanical Condition of the Respiratory Movements in Man," by Arthur Ransome.—"Further Experiments on the more important Physiological Changes induced in the Human Economy by change of Climate," by Alexander Rattray, M.D.—"On Linear Differential Equations" (Nos. VI. and VII.), by W. H. L. Russell, F.R.S.

Zoological Society, Nov. 19.—The Viscount Walden, president, in the chair. Mr. Sclater called attention to the two Livingstone expeditions into the interior of Africa now in preparation, and urged the importance of endeavouring to have zoological collections made in the countries about to be traversed by them.—Mr. A. D. Bartlett read some notes on the birth of the hippopotamus which had been announced at the last meeting of the Society. Mr. Bartlett called particular attention to the fact that on one occasion the young one appeared to have remained under water, without coming to the surface to breathe, for nearly fifteen minutes, and also pointed out that this was the first instance of the hippopotamus suckling her young in captivity.—A communication was read from Mr. W. H. Hudson, of Buenos Ayres, containing notes on the habits of the Vizcacha (*Lagostomus trichodactylus*), and giving some interesting details of its manner of forming burrows and living in society with other animals.—A communication was read from Mr. George Gulliver, F.R.S., containing observations on the size of the red corpuscles of the blood of the Salmonidæ and of some other vertebrates.—Dr. A. Günther, F.R.S., gave a notice of a snake from Robben Island, South Africa, living in the Society's gardens, which appeared to belong to a new species proposed to be called *Coronella phocarum*.—A communication was read from Mr. J. Brazier, containing a list of the species of *Cassidæ*, found on the coast of New South Wales, with remarks on their habitats and distribution.—A communication was read from Mr. Andrew Garrett, of Tahiti, in which he gave a list of the species of *Mitridæ*, collected at Rarotonga, Cook's Islands.—A communication was read from Mr. W. H. Hudson, containing some further observations on the swallows of Buenos Ayres, being supplementary to a previous paper on the same subject.—A communication was read from Dr. J. E. Gray, F.R.S., containing notes on *Propithecus*, *Indris*, and other Lemurs (*Lemuriana*) in the British Museum.

Linnean Society, Nov. 21, Mr. G. Bentham, president, in the chair.—On the *Compositæ* of Bengal, by C. B. Clarke. The author corroborated Mr. Bentham's estimate of the very small proportion of *Compositæ* relatively to the whole flora of flowering plants in the Indian peninsula as compared with other countries. In Bengal they show only the proportion of about one in twenty-two, and in Malacca the still smaller proportion of one in about forty-five species. The number of Indian species of *Compositæ* in De Candolle's "Prodromus" will probably have to be considerably reduced.—On Diversity of Evolution under one set of external conditions, by Rev. J. T. Gulick.—The author recapitulated the facts connected with the distribution of the *Achatinellinæ* in the Sandwich Islands, familiar to readers of this journal, and drew some general conclusions.

Chemical Society, Nov. 21, Dr. Frankland, F.R.S., president, in the chair.—A paper on the "Standardising of Acids," by W. N. Hartley, was read by the secretary. The author finds it convenient to prepare the solution for rapidly standardising acids by dissolving a known weight of metallic sodium in alcohol and diluting the solution with water; it is then ready for use. A second communication on anthraflavic acid, by Mr. W. H. Perkin, F.R.S., included an account of two new derivatives, diacetyl-anthraflavic acid and dibenzoyl-anthraflavic acid.

Anthropological Institute, Nov. 19, Sir John Lubbock, Bart., M.P., in the chair.—Mr. Heath read a paper on the Moabite jars and inscriptions lately purchased by the Germans. The author entered first into the philological and other arguments in favour of their authenticity, which the English authorities had denied. Certain points in which the Moabite stone had been hitherto considered to throw light upon the earliest forms of Hebrew were shown to be decided differently by these jars, so that the question was still open. The following was given as the inscription on the first jar:—"Inscription on his jar dedicated by Jai, servant of Isaac in Mesha, such as is raised in devotion to Nataracu. This is a devotion to Dov, wife of Domiodu, the same who in the might of her knowledge has been incorporated with Mesho. She is united with Hachuasho in Mesha, raised to unity with Daocush. May he be gracious." In the discussion which ensued it was maintained that further evidence of the actual specimens or casts from them was necessary to the final determination of the authenticity of the jars.—A paper by Capt. Burton was also read on human remains from Thorsmörk, in Iceland, describing the conditions under which parts of a human skeleton were found under a cliff where much rocky matter, possibly moraine, has fallen. No date was given to the relics, which tradition assigned to the time of "Burnt Njah." Dr. Carter Blake gave a particular description of the bones and skulls found, which appeared to accord with those of the Norwegians. He was unable to detect Esquimaux, Irish, Lappish, or Russian affinities. The horse was larger than the present Icelandic horses.

Geologists' Association, November 1.—Mr. T. Wiltshire, president, in the chair.—"On the Influence of Geological Reasoning on other branches of Knowledge," by Mr. Hyde Clarke.

Entomological Society, Nov. 18.—Mr. H. W. Bates, F.L.S., in the chair.—Mr. S. Stevens exhibited an example of *Vanessa antiopa* captured by Mr. W. C. Hewitson in his garden near Weybridge, so lately as the 1st inst. Mr. H. Vaughan exhibited *Crambus verellus*, a moth new to Britain, captured at Folkestone by Mr. C. A. Briggs; also varieties of *Vanessa Atalanta* and *Pyrameis cardui*. Mr. Meek exhibited *Nephopteryx argyrella*, a species of *Phycidæ* new to Britain, from near Gravesend; also varieties of Lepidopterous insects. Mr. Meldola exhibited a beautiful drawing of the dark form of the larva of *Acherontia Atropos*. Mr. Wallace forwarded exuviæ of some insect, apparently of the family *Tineina*, which had committed ravages amongst the dried mosses and lichens collected by Dr. Spruce, in Brazil. Mr. Müller read notes on the entomological papers existing in the "Verhandlungen der Schweizerischen Naturforschenden Gesellschaft," from 1823 to 1864.

Celtic Society of London, Nov. 12.—Dr. Carter Blake read a paper on the Celtic and pre-Celtic populations of Western Europe. After pointing out the value to be attached to traditions of pre-Celtic races, the author commented at length on the extravagant statements of Schlotheim, Berghaus, and Jagel with regard to the alleged diminution of the Celtic race. He gave a description of the *races maudites* of France, especially of the Cagots, Burhins, and Chizerots, adopting the conclusions of M. Francisque Michel, and denying the affinity of the pre-Celtic tribes to the Basques or to the Laplanders, calling attention to the confusion which existed between the various definitions of the Celtic race, the "Celts" of history, of tradition, of philology, and of craniology not being in accordance with each other. The author defined the cranial characters as those which were most permanent and best defined, such characters assigned to the Celt features, which had been described by Beddoe, Pike, and Davis, and which the author amplified at length. In conclusion he partially adopted the opinions of Dr. Knox on the moral and mental characters of the Celts.

Cambridge

Philosophical Society, Nov. 11.—The following communications were made to the Society by Mr. W. Kingsley. 1. Certain advantages in E. B. Denison's Gravity Escapement Clock for recording time by electricity. 2. Description of a Remontoir Clock invented by M. Groux. 3. Observations on certain districts in North Wales with reference to the final wasting and disappearance of the glaciers. In the last of these papers the author called attention to the evidence that Wales had in the glacial epoch been occupied by a great ice sheet from which only the summits of the mountains had projected. Much of the so-called drift on them, he urged, was only moraine matter deposited and spread on slopes during the retreat of this ice-sheet, when it had shrunk up into true glaciers occupying the valleys. He described the distribution of this and the arrangement of some of the moraines; and in conclusion called attention to a very remarkable deposit consisting wholly or almost wholly of diatoms, which existed in many of the mountain lakes of North Wales. The diatoms in these were identical with species which came from Greenland.

NORWICH

Norfolk and Norwich Naturalists' Society, Oct. 29.—A list of West Norfolk fungi was contributed by Mr. C. B. Plowright. It appears that Mr. Plowright has collected and identified no less a number than 600 species of fungi within a radius of fifteen miles round Lynn; these have all been gathered by himself, but he hopes, through the assistance of several gentlemen in other parts of the country, to extend the area included in the list, and add largely to the number of species, the total number of British fungi being about 3000 species.

PHILADELPHIA

Academy of Natural Sciences, May 7.—Mr. Thomas G. Gentry called the attention of the Academy to what he regarded as a rare and remarkable case of hybridism, which occurred between *Macacus nemestrinus*, male, and *Macacus cynomolgus*, female. After exhibiting an alcoholic specimen of the young, and a stuffed specimen of the mother which was clearly identified as *Macacus cynomolgus*, he detailed the leading characters of the two parents. He stated that the male differed from the female in being more robust and of greater dimensions; in the almost perfect smoothness of the face, which is of a pale flesh colour, while in the female it is black and invested with a close growth of short black hairs; in the absence of a crest upon the head of the male, which is a prevailing characteristic of the species (*M. nemestrinus*), and its presence in the female, which is a prominent feature of the species to which she belongs; in colour; and, lastly, in the unequal development of the caudal appendage, which in the male is about seven inches in length, and densely clothed with long hairs, while in the female it is twice the length, and nearly naked for more than two-thirds of its extent.

May 14.—Mr. Thomas Meehan observed that on several occasions, he had offered some facts and suggestions tending to prove that what are popularly termed Pine needles are not properly leaves, but rather branchlets, which, through the real leaves becoming attached for nearly their whole length to the axis or stem, had of necessity taken on themselves the office of leaves. He now wished to offer two additional observations in favour of the axial origin of these so-called leaves. In plants in general the leaves unfolded contemporaneously with the branches or axis. He could not call to mind an instance where the axis first extended to its full length before the leaves ventured to push forth from the nodes. The axial buds usually remained dormant until this final length was approached. When this occurred, or if anything happened to destroy the apex of the growing shoot, then the axial buds pushed into growth, and never to any great extent before. In the Pine family we had the following axial experience:—The buds which bore the needle were axial buds, situated at the base of the scale—the adnated leaf as he maintained. These buds remained nearly at rest until the axis had reached its full length, and in this respect coincided with the axial buds of trees in general. A pine tree in the spring season presented the appearance of an immense chandelier, with its long axial shoots as the naked burners. In this respect it is apparent that, regarding the fascicles of pine needles as branchlets, the law of folial development coincidental with axial growth finds no exception in the pine family. The next striking consideration was one derived from the nature of the inflorescence. In vegetable morphology, the floral system of plants was made up of neither leaf nor axis separately, but conjointly of both. In the inflorescence of the pine, the male catkins each took the place of a fascicle. The axial bud at the base of the leaf scale, instead of a bunch of needles, developed as a spike of flowers. This spike or catkin is metamorphosed needles. If these needles were leaves merely, we could hardly expect inflorescence to be formed from them. It would be an exception to regular rule. But regarding the needles of the pine as rather axis than leaf, their development to flowers acords with general law; and he held that it was more philosophical to accept conclusions based on general law than to hunt for new laws to account for apparent exceptions to general rule.

BOOKS RECEIVED.

English.—Biblical Psychology: J. L. Forster (Longmans).—A Manual of Elementary Chemistry: G. Fownes; 11th edition, revised and corrected by H. Watts (Churchill).—Principles of Psychology, 2 vols.: H. Spencer, 2nd edition (Williams and Norgate).—The Electro-thermology of Chemistry, T. W. Hall (Edmonson and Douglas).—Figures Made Easy: L. Hensley (Macmillan).—Easy Lessons in Arithmetic, Part I: Rev. B. Smith (Macmillan)—Records of the Rocks: Rev. W. S. Symonds (Murray).—Anecdotal and Descriptive Natural History: A. Romer (Groombridge).—Fair Mary's Dream: A. F. L. (Groombridge).—Ivy, its History and Characteristics: S. Hibberd (Groombridge).—Buds and Blossoms (Groombridge).—On Building and Ornamental Stones: E. Hull (Macmillan).

Foreign.—Lehrbuch der Physik: Dr. Paul Reis (Leipzig: Quandt and Händel).—Internationales Wörterbuch der Pflanzen-namen: Dr. W. Ulri (Trübner).—Through Williams and Norgate:—Optisch-akustische Versuche: G. Mach.—Die Robbe und die Otter: J. C. G. Lucae.—Die Anwendung der Spectral-apparates: K. Vierordt.

DIARY

THURSDAY, NOVEMBER 28.

SOCIETY OF ANTIQUARIES, at 8.30.—The Milites Stationarii considered in Relation to the Hundred and Tithing of England: H. C. Coote, F.S.A.

MONDAY, DECEMBER 2.

ENTOMOLOGICAL SOCIETY, at 7.

VICTORIA INSTITUTE, at 8.—Force and Energy: C. Brooke, F.R.S.

TUESDAY, DECEMBER 3.

ZOOLOGICAL SOCIETY, at 8.30.—On the Osteology of the Marsupialia. IV. Phascolomys. Bones of the trunk and limbs: Prof. Owen, F.R.S.—Contributions to Ornithology of Madagascar, III.: R. B. Sharpe.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.—On a Cuneiform Inscription containing the Chaldean Account of the Deluge: G. Smith.—Address by Sir Henry Rawlinson.

LONDON INSTITUTION, at 4.—On Elementary Physiology: Prof. Rutherford.

ANTHROPOLOGICAL INSTITUTE, at 8.—Report on Anthropology at the Meeting of the British Association at Brighton: Col. A. Lane Fox.—On Some Implements bearing Marks Referable to Ownership Tallies and Gambling from the Caves of Dordogne: Prof. Rupert Jones, F.R.S.—Discovery of a Flint Implement Station in Wishmore Bottom, near Sandhurst: Lieut. Cooper King, R.N.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion on the Aba Sugar Factory.

WEDNESDAY, DECEMBER 4.

GEOLOGICAL SOCIETY at 8.—On the Tremadoc Rocks in the Neighbourhood of St. David's, South Wales, and their Fossil Contents: H. Hicks, F.G.S.—On the Phosphatic Nodules of the Cretaceous Rock of Cambridgeshire: Rev. O. Fisher, F.G.S.—On the Ventriculidæ of the Cambridge Upper Greensand: W. Johnson Sollas.—Observations on the more remarkable Boulders of the North-west of England and the Welsh Borders: D. Mackintosh, F.G.S.

SOCIETY OF ARTS, at 8.—On the Manufacture of Horse-nails by Machinery: J. A. Huggett.

MICROSCOPICAL SOCIETY, at 8.

LONDON INSTITUTION, at 7.—The Paraffin Industry: F. Field, F.R.S.

THURSDAY, DECEMBER 5.

LINNEAN SOCIETY, at 8.—On the Skeleton of the *Apteryx*: Thomas Allis.—On New and Rare British Spiders: Rev. O. P. Cambridge, M.A.

CHEMICAL SOCIETY, at 8.—On the Reducing Power of Phosphorous and Hypophosphorous Acids and their Salts: Prof. C. Rammelsberg.—On Hypophosphites: Prof. C. Rammelsberg.—On New Analyses of Mineral Arseniates and Phosphates: Prof. A. H. Church.

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ERRATA.—No. 159, p. 30: The foot-line of Fig. 1 is erroneously "Metamorphosis of Tortoise-shell Butterfly," instead of "Metamor of *Sphinx Ligustri*."—No. 160, p. 55, 1st col., line 36: For "Mr. Geikie" read "Mr. James Geikie."

THURSDAY, DECEMBER 5, 1872

THE COMETARY STAR-SHOWER

SOME months have now elapsed since an announcement by Mr. Hind informed astronomers that a well-known telescopic comet, first seen in the years 1772 and 1805, and rediscovered in 1826 by the astronomer Biela, of Josephstadt, in Bohemia, when it was first recognised as periodic, would make its nearest approach to the earth towards the close of this year; and its apparent place on successive nights was duly foretold, to assist them in their search for its existence. On the last two occasions of its expected returns, in 1859 and 1866, no signs of the missing comet were detected. The favourable circumstances under which it was expected to be observed, during its last approach to the earth in 1869, and the absence of any notice of its having been seen during the last two months of its anticipated reappearance in the present year, makes it hardly doubtful that, as an interesting study and examination with the most powerful modern telescopes, it has at length ceased to be any longer visible. When at its greatest brightness in the year 1805, it was seen by Olbers, with the naked eye, and in its subsequent returns, it was frequently attentively observed with the most powerful means and by the most expert astronomers. During its appearance in 1846 it was first distinctly perceived to separate into two portions, gradually receding from each other until they gained a greatest distance, which was estimated on that occasion at 157,000 miles. The two portions remained visible as two distinct comets at their next return in 1852, with a widened interval between them, which had increased to 1,250,000 miles. With nearly equal brightness, and with perfect cometary appearance, these two bodies travelled side by side, and journeyed together, doubtless, to separate still further from each other in their further circulations round the sun. Such is the telescopic history of Biela's comet. In the year 1818 a telescopic comet was discovered by Pons, the astronomer, at Marseilles, whose date of appearance, at least a year before the time of a punctual return, cannot have been a reappearance of Biela's comet, but the position of its orbit, as far as it could be calculated from the imperfect data that were obtained, are so similar to that of Biela's that its relation to that comet appears not improbably to be of the same kind as that which formerly connected together the two portions of the recently divided cometary pair, and the orbit and periodic time of this third comet probably differ but little from those of the principal comet from which it may fairly be presumed to have been derived. Such groupings of comets on nearly parallel courses appear to be distinguishable in the more remarkable cases, recently pointed out by Hoek, of some comets with hyperbolic orbits; and the revolution of more than one telescopic comet is thought to have been discovered in the same orbit with the periodically-returning comet of 1866, with which the meteor-current of the great November star-shower, at its recent return, was shown by Schiaparelli, Adams, and Oppolzer, to be in remarkable agreement. In a later letter to the *Times*, in August last, Mr. Hind pointed out the satisfactory coincidence of which Prof. Schiaparelli, the former coadjutor of Secchi, and now the able director of the Observatory at Milan, was the first discoverer, between the orbit of another comet of considerable brightness seen in 1862, and the course of the meteors of the well-known August star-shower, an unusually bright display of which was recorded shortly after the appearance of that comet in the following year. Another example of distinct resemblance between the orbit of a meteor current and that of a periodic comet was early discovered by the German astronomers Drs. Weiss and Galle in the case of the meteor shower of April 19-20 and the comet I, 1861, to which Prof. Kirkwood, of the State University in Indiana, U.S., has lately added the interesting observation that the earliest records of this meteor shower, as well as of a conspicuous star-shower annually visible about October 18-20, indicate a periodic time in their maximum returns, which corresponds, like that of the November meteor system and its attendant comets, to an ellipse whose major axis is very nearly the mean distance of the planet Uranus from the sun. The time has thus arrived when systematic observations of meteor showers may be regarded as an important auxiliary to astronomers in certain cases where the orbits of comets are intersected by the earth's path, by vying with the telescope in detecting the hidden courses of such comets as, by comminution or disbanding of their substance, have so lost their brightness, as at length completely to elude their search.

The probability that the orbit of Biela's comet is marked by a considerable meteor stream was first shown, almost simultaneously, by the two eminent directors of the national observatories at Vienna and Copenhagen, Drs. Weiss and D'Arrest. The meteor stream to which the comet appears in this instance to have given rise, was principally observed in Germany, France, Belgium, and the United States of America, in the years 1798, and 1838, occurring on December 6 and 7 in those years; and again by the astronomer of Münster, Dr. Heis, at Aix-la-Chapelle, on December 6, 1847. Either of the periodical returns of the comets, 1818, I., or of Biela's comets, it was found by Weiss and D'Arrest, would perfectly account for the dates of appearance of these meteor-showers, and for the observed direction of their radiation from a point of divergence between Cassiopeia and Andromeda. The situation of this meteor stream is such that the meteors enter the earth's atmosphere with almost the least possible speed, of about eleven miles per second, that meteors can have; while the Leonides, or meteors of November 14, penetrate it with a velocity which is about four times greater. The position of the orbit is also such that it undergoes very rapid changes by the attractions of the planets; so that, while encountering the earth on December 7 in 1798, the meteor particles, at the last visible return of the comet in 1852, must have extended across that point in the earth's course which it passed on November 28 in that year. A few meteors from the same radiant point were seen by the late Signor Zezioli, of Urbino, the most zealous contributor of shooting-star observations to Prof. Schiaparelli, on November 30, 1867, diverging from the indicated place. The probability that the shower formerly witnessed on December 6 and 7 has thus advanced with the node of the comet's orbit to an earlier date in November, is now fully corroborated by the conspicuous appearance of the same meteor-shower which has recently appeared. Had it, indeed, been possible to estimate exactly the motion of the comet's nodes during the interval since their previous return, the date on which the great meteor-shower observed on Wednesday last occurred, might have been accurately foretold. The Luminous Meteor Committee of the British Association requested observers to co-operate for its observation on the evenings of the 28th to 30th of last month, and to keep an occasional watch for its return from the 25th until the last day of November. The observations received from some of these observers are ample proofs of their success; and among the copious descriptions of the shower which have appeared by many expert astronomers throughout the kingdom, little can be desired to increase the extent or accuracy of the information which has been obtained. Should it, however, be observed that a star shower like that seen by Heis, and earlier observed on the 6th and 7th of December, is again visible on about the 5th of December in this year, its connection with the companion comet I., 1818, of Biela's comet, may become a matter of interesting deductions from such observations, and of further satisfactory investigations.

A. S. HERSCHEL

FERMENTATION AND PUTREFACTION[*]

II.

IN the interesting inquiry into the life-history of mildews, a well-known one, abundant wherever organic matter, in a somewhat inert state, is exposed to damp, *Aspergillus glaucus*, may be taken as well as the *Mucor mucedo*. This consists in the first place of a mass of mycelium filaments, which are formed of delicate cells in chains, that is to say, the fibres are divided into series of true cells by diaphragms. The cells are full of protoplasm, at first showing a distinct nucleus, and afterwards a number of vacuoles containing water. The filaments grow at the ends, and new partitions there grow up—at first close together, and afterwards separating and becoming more distinct. Some of the filaments become spiral at the end and finally develop peculiar reproductive organs which will be noticed presently. *Aspergillus* frequently presents for long nothing but this spreading jointed mycelium, feeding upon the surface, and penetrating into the substance of organic matter, and rotting and burning it; producing water, carbon dioxide, sulphuretted hydrogen, various butyric compounds, and other products of decomposition, without developing any special organs of its own. In this state it is perfectly impossible to distinguish it from the mycelium of many other fungi. No doubt there are differences—there are marked differences from some mycelia, for instance those of the Mucors where the filaments are undivided—but most have divided filaments, and these organs are so small, so simple, and so variable, that it is next to impossible to appreciate the distinctive characters. Under favourable circumstances, in the light and air, *Aspergillus* rises into the form of a bluish mould. This under the microscope shows a multitude of one-celled upright stalks, which form a kind of fur on the surface which it has attacked. Each of these stalks, which may be called *conidia-stems*, is dilated at the upper end, and from this dilatation there project, bristling all over the knob, a number of conical protuberances called *sterigmata*. Each sterigma becomes pointed towards its free end, and at length produces at the point a small round cell filled with protoplasm, which remains attached to the sterigma by a fine pedicel. Behind this cell, between it and the end of the sterigma, another cell then forms, and then another, until little chains of cells stand out free from the ends of the sterigmata; and as all these are of the same age, they are symmetrical, and of the same length. The farthest from the sterigmata are, of course, the oldest, and some of these soon get dry and ripe; so that an impalpable dust of these propagating buds or *conidia* is perpetually coming off, wafted by the slightest breath, or even by the imperceptible convection-currents from which the air is never free, from the surface of a mould patch. The conidia are buds capable of germination, of producing plants which go through the same course as their parent, but they are not reproductive products. At the ends of the spiral curls of the mycelium filaments at certain seasons, and under favourable circumstances, large bodies are produced by a form of conjugation in which cells are multiplied till they form a mass of considerable size of a bright yellow colour, called a *utricle*. Some of the cells composing the utricle become dissolved while the greater number are developed into oval sacs or *asci*, in each of which eight spores are produced. These utricles are the true sexual reproductive organs. We have thus two kinds of spores—conidia, which are non-sexual buds, and asci-spores, the product of a form of sexual union. *Aspergillus* often bears conidia without utricles, and this is always the case when the fungus is badly nourished. It never, apparently, bears utricles without conidia. The appearance of the two modes of reproduction is so different, that the name *Aspergillus* was, until lately, restricted to mycelium bearing the conidia form of multiplication, while the utricle-bearing filaments and utricles were placed in another genus, *Eurotium*.

When sown, say on a solution of sugar or on any other suitable soil, the behaviour of the two kinds of spores is exactly the same. The spores send out tubes, which take the character of mycelium; and whose filaments in either case subsequently bear conidia or utricles according to circumstances.

Botrytis cinerea, a fungus specially abundant on decaying vine-leaves, produces conidia in elegant panicles, and a utricle which assumes such large proportions, and so a definite form, that it has been placed in the great genus *Peziza*, under the name of *P. fuckeliana*.

Not to multiply examples too much, I will briefly refer to a form, the life history of which is not yet thoroughly known—the mould which so often occurs in sour milk, though it is by no means confined to that station—*Oidium lactis*. The mycelium of *Oidium* is extremely like that of *Aspergillus glaucus*, having filaments divided into distinct cells by marked septa. From the mycelium long [illegible] shoots rise in the air, and give off chains of conidia, each shoot representing one of the sterigmata of *Aspergillus* with its progeny. *Oidium* attacks all kinds of fermentable substances, and consequently its conidia are frequently, almost constantly, met with in fæcal matter l, like many other innocent fungi, it has had the credit producing the Asiatic cholera, and rejoices, among er synonyms, in the name of *Cylindrotænium choleræ*. n solutions containing sugar we often find a mul- de of round or oval cells, precisely resembling the cells ich I have already described in other fungi; a delicate mbrane surrounding a mass of protoplasm, with one two water vacuoles; each cell is about $\frac{1}{100}$ mm. in meter; the cells are in twos or threes, or frequently n together in strings, like a breaking up chain of gem- les of a *Mucor*. These are the well-known *Saccharo- ces cerevisiæ*, the yeast fungus. In multiplying, which ey do with extraordinary rapidity, these yeast cells throw irregularly from the surface one or more buds, much as her fungi produce conidia. These separate, and in rn multiply in the same way; but the last stage in e development of this fungus is one which brings into the regular series of ascomycetous fungi, the rmation of regular asci or utricles, which corre- ond exactly with the asci of *Aspergillus*. These ntain four to eight spores, which, when placed under vourable circumstances, vegetate in the ordinary way. is after the sprouting of fresh yeast has taken place for me time in a fermenting solution, and has become nguid, that the formation of asci begins, and we can roduce them artificially by taking yeast out of a solution f sugar, and placing it upon the surface of a fresh vege- ble, such as a slice of carrot. From yeast we pass to a ries of very nearly-allied forms, which, as we shall see ereafter, perform a somewhat different function, the ifference altering their value prodigiously in human conomy. In sour wine and beer, in the process of he manufacture of vinegar, and wherever we have hat is called the acetous fermentation, minute bodies warm in the solution which closely resemble yeast, iffering chiefly in the smaller size of the cells. Some- imes these appear in pairs, sometimes single, and sometimes as little vibrating jointed rods. The best known, and perhaps the most mischievous, are the mould fungus of sour wine, *Mycoderma vini*, and the "mother of vinegar," *Mycoderma aceti*. These are called *Mycoderma* because the cells are entangled in a sort of slimy film.

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[*] From the Opening Address for the Session 1872-73 to the Botanical Society of Edinburgh, delivered on Nov. 14, by Prof. Wyville Thomson, F.R.S., President of the Society. Concluded from p. 62.

From these we pass to another class of bodies scarcely distinguishable from them morphologically, but usually even still more minute, which are universally spread wherever putrefactive decomposition is going on, *Bacteria* and *Vibriones*. These and the lactic acid, and butyric acid yeast-fungi cannot, however, so far as we at present know, be ranged with the *Ascomyceti*, but must be placed in another group, for which the term *Schyzomyceti* has been proposed parallel with the Nostocs among Confervoids.

Having thus given a very brief sketch of the morphology of this singular group of beings, I should wish to make one or two general remarks. In the first place, with De Bary, I would exhort you to remember that these beings whose morphology we have been discussing, although they are very small, are nevertheless *plants*, each going through its own life-history, and presenting at different periods, and in connection with the performance of the different functions of its life, definite forms like every other plant. You know how to think about peas and beans, oats and rye-grass, and after sowing a crop of peas you never go and watch it, wondering whether it will come up peas or barley. You never watch the growth of a turnip, expecting to find it gradually turning into a carrot; and you never set aside a bowl of gruel and wait till acorns come in it, and wonder whether, if they do come, they will sprout into cabbages or hedgehogs; and yet there are slight difficulties in the study of the plants which we have been describing which have led men apparently otherwise well instructed to write reams of trash, gravely advocating absurdities of essentially the same order. These difficulties are in the first place that these plants are extremely minute, and their investigation requires great skill in manipulation, and great practice. Again, they are enormously abundant, and their multiplying germs of all kinds are so minute and all-pervading that it requires the utmost experimental dexterity to separate them, to sow them, and still more to exclude them. If we attempt to select and sow one species, ten to one the seed is mixed with the seeds of a multitude of weeds, and if during the process we allow the most indirect and instantaneous communication with the open air, instantly the enemy sows tares among our wheat, and one of these, probably more vigorous than the others, in the course of an hour has cut short its weak struggle for life. Then the form of these plants requires very careful study—some parts of them, such as the universally diffused mycelium, are undistinguishable in different species; and so are the gemmules, conidia, and spores examined singly. It is often only when the entire "fructification" is present that distinguishing characteristics exist which one can grasp. Then there is another difficulty—most of these plants present some form of the singular phenomenon of pleomorphy; perhaps not more so than other plants, but slight differences in form tell greatly in such simple and critical organisms. They present different forms at different periods of growth, and under slightly different circumstances. It is therefore not the appearance of the particular mould-fungus at any one time which we have to consider, but its life history. In this, however, as in all other such cases, we must apply the ordinary rules of experience and common sense. A plant of rhubarb, pink and clear, drawn up and forced in a can, is very unlike the same plant grown outside, with great green leaves and giving off a multitude of multiplying buds from its root crown; and without some little knowledge and experience it would be difficult to identify either of these with the plant in the autumn in its reproductive stage, shooting up its stately axis with its myriad of white feathery flowers. The difficulties in studying the small fungi are very great, but a few men, not perhaps very many, are capable of dealing with such difficulties, and by the application of the methods and reasoning of such men as De Bary, Pasteur, Lister, Burdon Sanderson, and Hartley, men trained in skilful investigation and accurate thought, the wild misconceptions which have lately gathered about the whole subject are fast passing away.

I will now turn for a few minutes from the morphological to the physiological part of the question, from the researches of M. De Bary to those of M. Pasteur.

These active little scavengers, the microscopic fungi, live upon and in, spread their mycelium over and through, and flourish on the surface of decaying vegetable and animal matter; but it is not the decay which produces the fungi, it is the fungi which produce the particular form of decay.

When a mildew is growing in the ordinary way in the free air on the surface of a liquid containing sugar, or on the surface of a plant, it absorbs oxygen from the air, and combines the oxygen thus absorbed with carbon, the product of the decomposition of the matter on which it is growing, so that by this ordinary process of burning, carbon dioxide and water are set free, while at the same time putrefaction is kept up in the substance attacked. If protein compounds be present, then ammonia, sulphuretted hydrogen, and other substances are likewise set at liberty, making the putrefaction more offensive. The fungus is, in this case, feeding upon the organic matter, and breathing the oxygen just like an animal. It cannot decompose carbonic acid if it be freely supplied with this gas. Without any other source of carbon, it does not increase. The relation of fungi to the other substances required for their growth is still uncertain. It has been supposed, and experiment seems to favour the opinion, that fungi can assimilate the nitrogen of ammonia and nitric acid, and even that they can absorb and assimilate the nitrogen of the air. I should think this very doubtful. It would seem most probable that in their relation to their surrounding sources of nourishment, their reactions are the same as those of animals and of the pale parts of the higher plants.

Pasteur has shown that the same plants which, when growing fully exposed to the air and liberally supplied with oxygen, produce putrefaction, will, when partially or wholly excluded from the air, and deprived of a full supply of oxygen, produce fermentation—that is to say, will induce and keep up a set of changes resulting in the production, not of carbonic acid and water, but of alcohol, or of acetic, butyric, or lactic acid.

The *rationale* of this process proposed for acceptance by Pasteur is singularly beautiful, and will, if correct, cause a great change in our ideas of the vital relations of these lower living forms. He believes that ferments are living beings with this special property—that they can perform all their vital functions without being in contact with free oxygen gas; that they can take the oxygen which is necessary for their respiration, and for other changes in the organic matter upon which they are feeding, from organic compounds containing oxygen, such as sugar; that they can decompose and burn these, and in doing so induce in a large quantity of fermentable material the conversion of sugar into alcohol. Pasteur cites the following experiment:—

If we half fill a flask with a fermentable liquid such as a solution of sugar, and having taken all care to exclude all other germs, sow on its surface some spores of *Mycoderma vini* or *Penicillium glaucum*, the fungus grows and flourishes on the surface, feeding on the organic matter in the solution, absorbing oxygen from the air, and throwing off carbon dioxide. In this case no alcohol is produced. If we now shake the flask, the film of fungus sinks through the liquid, and for a time there is no further change; but after resting a little, if the temperature be kept up, bubbles of carbon dioxide begin to rise from the fungus, which continues to grow, although more slowly. Fermentation sets in instead of putrefaction, and alcohol is produced in sensible quantities. The one great change which has been produced in the circumstances of the fungus is that it has now been almost wholly excluded from contact with free oxygen, while in its former condition it was bathed in it. Upon this change, according to Pasteur, depends its now acting as a ferment instead of inducing putrefaction.

A ferment, then, is a living body which is special in this respect; that it is capable of performing all the functions of its life apart from free oxygen; it can assimilate directly oxygenated matters such as sugar, and derive from them the requisite amount of heat, and it further can produce the decomposition of a much greater weight of fermentable matter than the weight of the ferment in action. Pasteur has found that ferments such as yeast lose their fermenting power—that is to say, the amount of organic matter decomposed diminishes and approaches the weight of the ferment employed—exactly in proportion to the amount of free oxygen supplied.

Pasteur has also shown, and this is one of the most curious results of his investigations, that the same fungus does not incite or maintain the alcholic, the acetic acid, the lactic acid, or the butyric acid fermentations; but that these changes are produced by different species, nearly allied but distinguishable from one another under the microscope; the specific differences between them extending to this strange difference in their powers of nutrition or respiration which induces different reactions in a fermentable fluid.

In the course of the foregoing remarks we have digressed widely from our text, the ripening and rotting "Duchesse d'Angoulême" pears; but, before concluding, let us for a moment recur to them, and see how far the facts and theories which I have brought before you are applicable to the considerations from which we started—their ripening and their decay. This ripe pear, during its early growth, was green. The cells in its outer layer contained chlorophyll, and contributed their quota to the shaking asunder of the elements of carbon dioxide and water under the influence of light—to the nutrition of the pear tree. Its inner pale cells grew, amply supplied with food from the elaborated sap, and with oxygen suspended in the percolating fluids and passing through the many ducts. Thus at that period growth was going on, and neither fermentation nor putrefaction. Sugar, starch, and various substances were then laid down in the cells, and when the pear had acquired its full growth, the connection with the tree was cut off, but the surface of the fruit remained still freely exposed to the air. A considerable quantity of sugar is now decomposed in the interior of the fruit, and the result is the production of a trace of alcohol and certain ethers—the development of the flavour of the pear; but shortly the outside softens by the ordinary production of water and carbon dioxide in contact with the oxygen of the air, the pear loses flavour again, and commences to decay. M. Bérard has shown that if a ripening fruit be placed in an atmosphere of carbon dioxide no such softening occurs. The changes are much less rapid, the inner cells of the pear act as a ferment, and while carbon dioxide is still given off it is now at the expense of the sugar, and a large quantity of alcohol is the result. M. Pasteur tried this experiment with four dozen "Monsieur" plums taken nearly ripe from the tree; twenty-four of these were placed in an atmosphere of carbon dioxide, and after several days, during which time ey seemed quite firm and fresh, they gave to analysis 50 grammes of absolute alcohol, and a corresponding iantity of sugar was destroyed; the other twenty-four were ft in contact with the air, and had became soft, watery, id sweet. It is the active vitality of a living plant, hich consists of materials very suitable for their con-imption, which prevents its being attacked by these pro-oters of putrefaction and fermentation. Our pears, after irning their substance for a time without any new supply, ecome weak, and fall an easy prey to their persecutors. 'he moment the soil is free there is no want of seed. I need ot reopen the old question and repeat that every breath f air is full of it. It is said that if you want a thoroughly ood pasture, the best way is to fallow your ground and eave it for thirty years. During that time you will have ver it a battle-royal for life. Every possible kind of eed will come to it from the four winds of heaven, and or a time it will be a wilderness of weeds; but soon the ood old law begins to work, and the weak go to the wall, nd the fallow bears a close sward of native British rasses. The same takes place in our pear, only what akes thirty years in a field is compressed into thirty iours, and probably before a much longer time has lapsed, its surface is enveloped in a luxuriant microscopic ungle of *Mucor stolonifer.* WYVILLE THOMSON

THE FINDING OF LIVINGSTONE

How I found Livingstone in Central Africa. By H. M. Stanley. (London: Sampson Low, Son, & Co.)

MR. STANLEY'S bold march from Zanzibar to the Tanganyika, and his perfect success in meeting with and relieving the greatest of our modern travellers precisely at the right moment, will ever form one of the happiest and most romantic pages in the story of African exploration.

Remembering the watchword of his mission, "Go and find Livingstone," and that this, not the discovery of new countries, was his great object, it seems almost invidious to notice that Mr. Stanley's journey must take a minor place among African travels of exploration, adding little to our knowledge of the exact geography of the continent. The path which he traversed is for the most part a frequented caravan route, running parallel to, and occasionally touching, the lines passed over and described by Burton, Speke, and Grant. Without the basis given by the labours of these explorers, Mr. Stanley's work would have had but small value, since he himself has not made a single observation of position or of elevation, and the compass-bearings contained in some parts of his book are not in any way checked for magnetic variation. Still, very considerable portions of Mr. Stanley's route pass through lands hitherto untrodden by Europeans, some parts even unvisited by Arabs, and of these he is undoubtedly the discoverer.

Three frequented caravan routes lead from the coast near Bagamoyo towards Unyamyembe, and of these Mr. Stanley chose the most northerly and direct, the others having been traversed by Burton, and Speke and Grant. In following this new line, Mr. Stanley has been able to mark out more clearly than the former travellers the separate basins of the Kingani and the Wami rivers of the coastland; and he points out the important fact that the latter might be navigated with ease by light-draught steamers for a distance of 200 miles inland from the port of Whinde at its mouth.

At the base of a spur of the Rubeho mountains, the edge of the high plateau of Eastern Africa, the unexpected scene of a walled town presented itself. This was Simbamwenni, the capital of Useguhha, and the recently-built stronghold of an usurper, "another Theodore on a small scale"; "the houses in the town are eminently African; the fortifications are on an Arabic-Persic model; well-built towers of stone guard each corner; four gates are facing each cardinal point, and, set half-way between the several towers, permit ingress and egress to the inhabitants."

Beyond the mountains which face the coastland, Mr. Stanley's route converged in the dry region of Ugogo to that of Burton and Speke, and hence to Unyanyembe he passed over their track. Arrived at Tabora in Unyanyembe (the name Kazeh, applied to this capital by Burton, appears to be now unknown), Mr. Stanley found the whole country to westward overrun by the gangs of Mirambo, the turbulent chief of Ugoweh, a place some 60 miles north-west of Tabora. This chief sternly refused passage to the Arab traders unless they would aid him in a warfare he was about to wage against the Sultan of the Wanyamuezi in Unyanyembe. After taking part in an ill-directed and unsuccessful attempt to dislodge the obstructive Mirambo, Stanley determined to strike out for himself a new path outside the disturbed region. In carrying out this resolve he led the way, in a semicircular track of more than 200 miles, through the forest countries of Utakama, Ukonongo, and Ukawendi, first south, then west and northward to where he again fell in with the ordinary trade route. The whole of the geography of this detour is new and interesting, and it forms the chief portion of the discoveries which are particularly Mr. Stanley's own.

The path chosen lay round the southern tributaries of the Malagarazi river, the largest known tributary of the Tanganyika, and along the water-parting between this basin and that of the Rungwa river farther south, which Mr. Stanley affirms to be also an influent of the lake, flowing through the marshy plain called Rikwa (the Rukwa lagoon of Burton and Speke). The direction of flow of the Rungwa is a most important point, since it had been suggested as probable that the Tanganyika might have its outflow through this marshy country to the Lufiji river on the east coast. This theory appears now to have no foundation.

Passing over the arrival at Ujiji, and the most fortunate conclusion of Mr. Stanley's direct mission in meeting the great traveller there, the next perfectly new portion of this journey is that in which Livingstone and Stanley together explore the head of the Tanganyika.* "We found that the northern end of the lake was indented with seven broad bays." "The fourth bay (at the head of which was the delta of the Rusizi), was about three miles in depth, and penetrated half a mile farther inland than any other." "Soundings indicated 6 ft., and the same depth was kept to within a few hundred yards of the principal mouth of the Rusizi." "We ascended about half a mile, the current being very strong (from six to eight miles an hour), and about ten yards wide, and very shallow. The question, 'Was the Rusizi an effluent or an influent?' was settled for ever."

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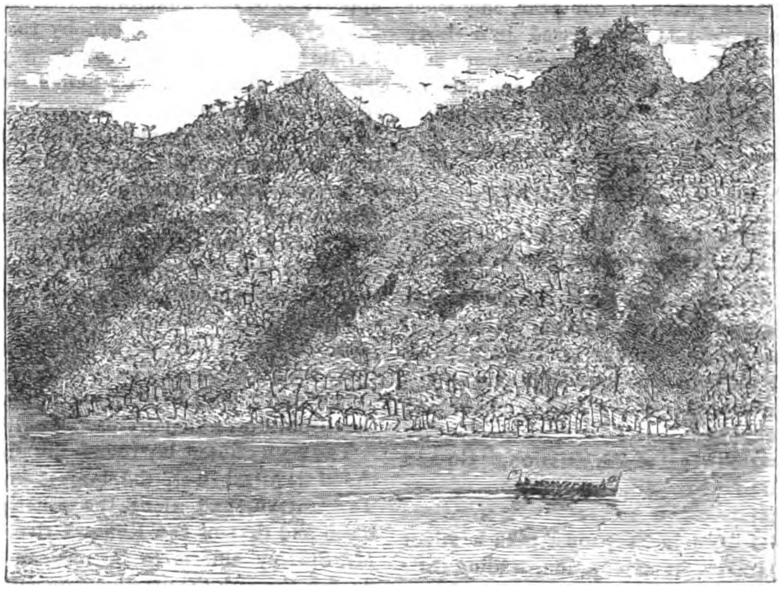
* Mr. Stanley prefers the spelling Tan-gan-ika.

Much, if not the whole credit of this discovery, the most valuable geographical point of the journey, is due to Mr. Stanley, who suggested to Dr. Livingstone the desirability of its examination and the completeness of the circumnavigation of the head of the lake, along with the presence there of the most experienced of African travellers, leave no possible doubt remaining. The view first taken by Burton and Speke is amply confirmed, and the Tanganyika has certainly no outlet at its northern end.

When approaching Ujiji, Mr. Stanley heard a sound as of distant thunder in the west, and on asking his guides if it were thunder he was told that it was Kabogo, "a great mountain on the other side of Tanganika, full of deep holes into which the water rolls," "Many boats have been lost there; . . . The sound of the thundering surf which is said to roll into the caves of Kabogo was heard by us, therefore, at a distance of over one hundred miles away from them." This story, in which Mr. Stanley himself does not appear to place much confidence, has suggested a possible outlet of the Tanganyika to the Lualaba system by subterranean rivers through the mountains which enclose the lake on the west; but, besides the extreme improbability of such a phenomenon, it is to be remembered that Livingstone, in coming to Ujiji from the Cazembe's territory, must have passed close to these dreaded caves, and would not have gone by them without exploring, or at least hearing of their existence. It is not recorded that Mr. Stanley consulted Livingstone on this subject.

A remarkable fact, which, taken in connection with our knowledge of the insignificant drainage to the Tanganyika, seems to lend still further confirmation to the view first expressed by Burton that "the Tanganyika, situated like the Dead Sea, may maintain its level by the balance of supply and evaporation," is Mr. Stanley's observation of a clearly marked high-water line of the lake on the rocky slope of a promontory south of Ujiji. "This went to show that the Tanganyika, during the rainy season, rises about 3 ft. above its dry season level, and that during the latter season evaporation reduces it to its normal level." On the contrary supposition of the existence somewhere of a considerable outflowing river from Tanganyika, it is difficult to account for such a rise and fall in a lake of upwards of 10,000 square miles in extent.



View on Lake Tanganika.

The occasional descriptions of landscape throughout the volume are exceedingly graphic; for example, the descriptions of the forest scenes in the newly traversed region of Ukonongo (p. 322) or of the park-like and pastoral country of the coast slope (p. 167). With such an appreciation of the great landscape features of the changing belts of country through which he passed, it is to be regretted that the pictorial illustrations of Mr. Stanley's book should, with so few exceptions, be devoted to personal incident. As in many books of travel, so here, a ship, a wild boar, an elephant, or a house, form the subject of the majority of the pictures, the real scenery of the country being thrown in only as a background to these objects, drawings of which may be readily obtained at home.

It is also a matter of regret that the chief map accompanying the volume does but scant justice to the observations recorded in its pages; a much more detailed representation of the routes might have been given. We look in vain, for example, for the position of Mount Kibwe, which is frequently mentioned as one of the highest peaks of the mountains of Usagara, and which is the subject of perhaps the best illustration in the book. Again, "Mukondokua had been reached after three hours' march direct west from Misanza," but upon the map these places are shown relatively north-west and south-east; Imreras, chief settlement in Ukawendi, and the objective point Mr. Stanley's return-route from the lake with Living-one is not to be found. The spellings of map and book e frequently at variance.

Two chapters of geographical and ethnological remarks ay have some value to the student, but do not appear to d much to the exhaustive descriptions of Burton in his Lake Regions."

Mr. Stanley gives very minute and apparently accurate escriptions of the various fishes of Tanganyika, and these re accompanied by a page of elaborate drawings. It is nfortunate, however, that some of the fishes to which the ame names are applied by Burton and Stanley do not gree in their dimensions; thus, the *Mvoro*, according to Burton, is "a long bony variety, in shape like a large mackerel;" whilst Stanley's *Mvuro* is a "thick fleshy ish, 18 inches long and 15¼ inches round the body."

The excellent chapter on the organisation of the expedition, in which Mr. Stanley gives to future explorers the benefit of his anxious study of the requirements of the expedition at starting, the native currency, quantities of cloth, beads, and wire necessary for the journey, the hire of native porters, and such like, deserves the highest commendation; and the truth of his remark that "however stay-at-home people may regard the merits of his book, the greatest praise and the greatest thanks will be bestowed upon it by travellers who may succeed me in East Africa" is already on the point of being verified.

OUR BOOK SHELF

Nachträge zu der Schrift über Inschriften und Zeichen in lebenden Bäumen, sowie über Maserbildung. Von Prof. H. K. Göppert. (Breslau: E. Morgenstern.)

PROF. GÖPPERT published in 1869 in the *Jahrbuch des Schlesischen Forstvereins* some observations on the singular inscriptions and other marks found within the stems of living trees, to which the present pamphlet is an appendix. The original tract was illustrated by four lithographic plates, and in this publication we find two more, illustrating the mode in which injuries to the wood become entirely covered over and concealed by the subsequent formation of cambium and growth of bark. The visitor to the British Museum will observe some very curious instances of this phenomenon in the botanical department, which possess the additional interest that the exact period is known when the inscriptions were made, and consequently the age of the subsequent overgrowth can be determined.

Des Préparations Microscopiques Tirées du Regne Végétal, et des différents procédés à employer pour en assurer la conservation. Par Johannes Grönland, Maxime Cornu, et Gabriel Rivet. (Paris: F. Savy. London: Williams and Norgate.)

OF the 75 pages of which this book consists, only the last 25 properly relate to the subject which is indicated by the title; all the rest are occupied by descriptions, of a very detailed and apparently accurate kind, of apparatus and various accessories to microscopic work, such as all but the most inexperienced are necessarily perfectly familiar with. A classification and account of the various kinds of turntables fills 8 pages at the beginning; diamonds and scalpels are afterwards treated of, with the method of sharpening the latter. A simple plan of mounting needles for dissection, which consists in inserting their blunt ends into the pith cavity of pieces of fresh twigs cut of the proper lengths, and then allowed to dry, and consequently shrink tightly upon them, will, no doubt, be found useful. The handles, however, for crochet-needles which are sold at berlin-wool shops achieve the same end by a simple mechanical contrivance. The triangular needles, by the way, mentioned by the authors, are known in England as glovers' needles, and are kept by some instrument-makers. Microtomes are discussed very minutely: they are, no doubt, very useful; but excellent sections are habitually made by those who use no contrivance of any kind. Imbedding in stearine is recommended in the case of Rivet's most ingenious section cutter; but when this is done it will be found that, with a little practice, the instrument can be quite dispensed with. It will hardly be worth while, therefore, for any one who wishes seriously to work at vegetable histology to expend 28 fr. upon it. A good hint is to coat the object to be cut with a thick solution of gum-arabic, which is to be allowed to quite dry before putting it into the melted stearine. By this expedient, when the section is thrown into water as soon as cut, the stearine is said to detach itself, and gives no further trouble. The manufacture of a slide and covering glass (pronounced *sliade* and *coveur*) requires an explanation of 16 pages. It is, perhaps, a doubtful compliment to find only the mechanical side of English microscopy getting any recognition. It may possibly be all we deserve; still, no serious worker in England would waste his time in carrying out the directions given here for cutting, trimming, and polishing the edges of glass slips, which can be so easily purchased ready-made. Directions for making preservative solutions form the last chapter, and these are probably of some value. A medium prepared by adding 4 to 5 parts (by weight) of glacial acetic acid to 100 parts of distilled water, with which 2 parts of chloroform have been agitated for some time, is stated to preserve the endochrome of minute algæ without contraction, and to have the enormous merit, when vegetable tissues are worked with, of absorbing bubbles of air. Another liquid, composed of 75 parts of water saturated with camphor, an equal quantity of distilled water, and 1 part of glacial acetic acid, is recommended in the warmest terms for the preservation of fresh water algæ. A great deal still remains to be done in the methods of vegetable histology. No one in England has probably as yet tried perosmic acid for plant tissues; and staining, which has proved so important an aid to animal histologists, never enters into the minds of the authors, even to the extent of mentioning the familiar carmine; much less the solution employed by Hanstein for colouring the cell-wall, consisting of equal parts of rosaniline (magenta) and aniline-violet (mauve) dissolved in alcohol.* Schulz's process for demonstrating the "intercellular substance" characteristically concludes what the authors have to say. On the whole, any person wishing to practise the preparation of vegetable microscopic objects merely as a matter of business on a large scale, will find it useful to possess this book.

W. T. T. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Ipecacuanha Cultivation at Kew

I HAVE just received No. 158 of NATURE, containing Prof. Owen's letter "On the National Herbarium." In that letter Prof. Owen quotes several sentences relating to ipecacuanha cultivation in India from my last report for the official year ending March 31, 1872, on the Calcutta Botanical Garden, with the object of substantiating an insinuation of bad cultivation at Kew. He does not, however, quote the whole of what I wrote about ipecacuanha in the report referred to, and the result is, that a casual reader of his letter would form the impression that, but for Edinburgh, ipecacuanha would not have been introduced into India, and that, consequently, the Kew establishment cannot be relied upon for the dissemination of useful plants among the British possessions abroad, which is, I imagine, one of "the works and applications for which a nation provides and supports its collections of living plants."

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* Bot. Zeitung, 1868, p. 708.

My report having been quoted with such an object, I wish to state that the success of ipecacuanha cultivation in India had been practically settled before any of the plants propagated at Edinburgh had arrived in that country. In the year 1866, and long before Government had begun to show any official interest in the matter, Dr. Hooker sent an ipecacuanha plant to the Calcutta Botanical Garden, the offspring of which, in Sikkim, amounted, in the month of September, 1871, to nearly 400—quite a sufficient number to assure a successful start to propagation on a large scale. The subsequent arrival in India of considerable supplies from Edinburgh has, indeed, made assurance doubly sure; but the fact remains that to Dr. Hooker is India indebted for the first beginning of this important cultivation.

If the establishment at Kew stood in any need of a testimonial as to the valuable assistance rendered by it in the introduction into India of plants of economic or horticultural interest, it would not be difficult to furnish a list sufficient to fill a good many columns of NATURE of the names of plants and seeds sent—many of them quite unsolicited—from Kew to Calcutta within the last ten years, to go no farther back.

GEORGE KING,
Superintendent Calcutta Botanical Garden
Nice, Nov. 26

The Great Meteoric Shower

As you will most probably have received from many other correspondents a general description of the magnificent spectacle on last Wednesday evening, I will confine my remarks principally to those observations which bear directly on the most important point at issue, viz., whether this meteor stream can be identified with the well-known comet of Biela. Having searched, during the autumn, on every available occasion for a glimpse at the approaching comet, and the almost unvarying cloudiness of the early morning sky having rendered even the negative value of the observations well-nigh useless, I read with delight the prediction of Dr. Weiss, and felt the greatest interest in its fulfilment.

Immediately I had noticed that a meteoric shower was in progress on the evening of the 27th, I directed the two assistants of the observatory, who have had considerable experience in tracing the paths of meteors during the last few years, to devote their whole attention to the accurate determination of the radiant point. In the meantime, with the assistance of three of the students of the philosophy class and of the meteorological assistants of the observatory, I noted the rate per minute, the velocity, direction, magnitude, &c., of the falling bodies.

The Radiant was found to be on the line joining γ and 51 Andromedæ, and twice as far from 51 as from γ. This gives as the R.A., 26° 37′, and N. Decl. 43° 48′, agreeing very well with the prediction.

The Epoch is somewhat in advance of that predicted; but this cannot be wondered at, as the comet has not been seen since 1852, and, in three complete revolutions round its orbit, it could scarcely have been expected not to have been subjected to considerable unknown perturbation, either from planets whose masses are imperfectly known, or perhaps from some neighbouring meteor-stream.

The time of the maximum was about 8h. 10m. P.M., but the numbers did not much diminish before 9 P.M., G.M.T. Between 8h. 47m. 30s. and 9h. 0m, the computer of the observatory counted 512, which gives 40 per minute for one observer, and therefore at least 100 per minute invisible. From 9 to 10 o'clock, at which time the sky became clouded, and remained so till morning, the mean rate was about 53 per minute, and almost constant from minute to minute, though varying much during each minute. At certain moments they were exceedingly numerous. Thus, at 9h. 19m. nine appeared at the same instant at a point near β Andromedæ.

A very peculiar feature of the display was the parallel motion of many stars that became visible at the same time. Thus, at 9h. 16m. five burst out close by γ Andromedæ, and travelled eastward together; at 9.25 four went together from γ Andromedæ to the Pleiades.

More than nine-tenths of the meteors were very faint, and the larger ones seldom attained to any very considerable magnitude. Most had tails; the almost invariable colour being a white star with a greenish-blue trail. The tails of those falling S.E. were observed to bend somewhat towards the E., and to be straight only during the first half of their path. The ratio of the numbers falling S.E., to those falling N.W., was as 3 to 2, but this excess may in part be accounted for by the position of the Radiant. More of the larger meteors went S. than N., and more W. than E. The track of the larger bodies rarely, if ever, exceeded 50°, and their velocity was very noticeably less than that of the 13th and 14th November shower, as might be expected, if their absolute velocities are comparable, the Radiant for November 27 being so far removed from the apex of the earth's way.

S. J. PERRY

Stonyhurst Observatory, Dec. 1

ALTHOUGH it is probable that you will receive full accounts of the meteoric shower of Wednesday, November 27, yet the following notes, imperfect though they be, may have some interest. I was prevented by indisposition from observing it myself, but the numbers were noted by Captain Brinkley, grandson of the great astronomer, and his sons:—

"Mr. Charles B., at 3 P.M., observed a bright meteor; Capt. B., at 4.35, another; at 5.20 the young men came in to announce an extraordinary display; and Capt. B. noted 34 in 1m. 30s.; Capt. B., looking north at 5.40, marked 95 in 5m.; Mr. John B., looking south at same time, marked 147 in 5m.; the radiant point was a little S.E. of the zenith; Mr. J. B., at 9, marked 26 in 1m.; Capt. B., at 12, marked only 7 in 5m. Many were large, and left trains."

It was remarked that the night was unusually light, while clear. A very thick fog appeared before the dawn of Thursday.

Castleknock, Dublin, Nov. 29 T. R. R.

A FINE display of shooting stars was observed here on Wednesday, 27th inst. I first noticed them at 7.20 P.M., Greenwich time, and watched them till about 8, when the sky became obscured. They were occasionally seen again till 9.30. When first observed they appeared to radiate from the zenith, and to be more numerous towards the north-west and south-west; many passed over the constellation Cygnus.

A. W. SCOTT

St. David's College, Lampeter, Nov. 30

DURING the recent star-shower, my attention was given especially to observations connected with the flight of individual meteors. As on many previous occasions in the presence of rare natural phenomena, I was keenly mortified with the deficiency of my own scientific training; but I send a few gleanings, if perchance a useful grain can be found amongst them. The brightness obviously increased with the distance traversed, but in many cases no increase of brightness was perceptible for the first third of the course. The extinction was not instantaneous but only very rapid, the distance traversed towards extinction being perceptible though very small; perhaps because the velocity seemed to diminish as the brightness increased. The train in many instances was forked, being brightest on its edges, the luminosity of which lasted for some time after the intermediate space was dark. This seems incompatible with the hypothesis that the train is a mere optical result, or that the brightness of the train arises, as in lightning, from incandescent particles of the atmosphere. In one or two instances the brightness of the train was granular, resembling the light of a partially resolved nebula, or of the Galaxy. In a few instances the paths of the meteors appeared to show remarkable deflections. One, notably, at 6h. 25m., close to Vega, resembled an "S" drawn out nearly straight.

The course of a body passing with great velocity though an elastic medium tends to follow the direction of least resistance. It is only in poetry that

"The lightning falls with never a jag."

And though, as compared with that of electricity, planetary velocity is small, say twenty miles per second, yet this error in a very attenuated atmosphere would produce an intolerable amount of resistance right ahead.

Looking for deflections arising from this cause I saw, or fancied I saw, some very remarkable ones, such as no rules of foreshortening or perspective would account for.

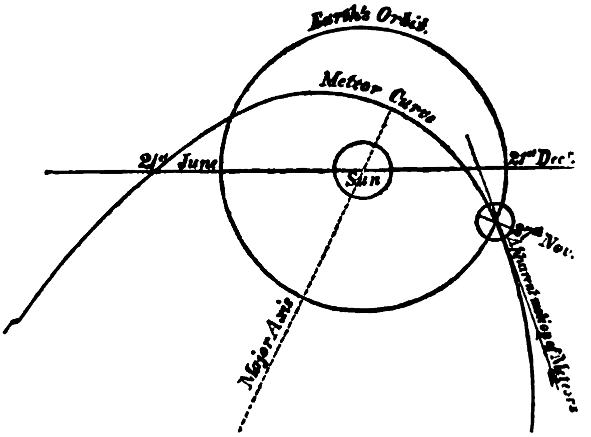
Rainhill, Dec. 2 HENRY H. HIGGINS

I HOPE last night, Nov. 27, was generally clear. It was so here, and we were treated to the most splendid meteoric shower that I have ever seen. I went out quite by chance into my garden at 7 P.M., and saw it in its full glory. I counted in a very few minutes 500 meteors, and then lost count, there being far too many to count all. On several occasions I saw as many as twelve in the sky at once: their radiating point seemed to be about ξ Cassiopeiæ, and from that point they floated in every direction—north, south, east and west. At that time, Cassiopeia being immediately above one's head, the effect was magnificent.

Malpas, Nov. 28 EDMUND V. PIGOTT

ON the 27th inst. a very fine display of meteors was observed here, which continued from about 5 P.M. to a late hour.

During 20 minutes of casual observation I counted 70 meteors—viz., from 7.45 to 8.5 P.M. One or two very fine ones were observed, one of which, having a northerly direction, left a luminous trail lasting for about 15 seconds. The radiating point was situated about 10° to S. and E. of the zenith. The apparent velocities varied considerably, no doubt due to the angle at which each meteor was seen. The appearance of the tails also varied, some giving a quiet steady light, others wavy or sparkling; reddish sparks appear to have been observed. At 9.35 I counted 11 in 2 minutes.



I have constructed the annexed diagram from my rough observations. W. J. M.

Glasgow, Nov. 29

A VERY fine shower of shooting stars was observable at Boltsburn, Rookhope, in Durham, on Wednesday night (27th inst.). I first noticed them about half-past seven, when they were very numerous; their directions were chiefly downward, towards nearly all points of the horizon. The radiant point seemed to be situated near the Great Bear, but of this I could not make myself perfectly satisfied. They varied much in magnitude and length of track. Some of the larger ones left a streak of reddish light on their track, which lasted a second or two. About eight o'clock I counted, in fifteen minutes, 600, which came within my field of vision from a doorway having a southerly exposure. The regularity of occurrence was such as to approximate closely to 200 during each five minutes. How long the phenomenon continued in the latter part of the night I had not the opportunity of ascertaining. JOHN CURRY

Rookhope, Durham, Nov. 29

THE following are the observations which I was able to make on the great shower of meteors on Wednesday last:—

The first which I saw was at 5.25 P.M. Between 5.35 and 5.50, 150 were counted by one observer in the sky towards N.E. At 6.26, in four minutes, five observers counted 310. At 6.40, in two minutes, five observers counted 316. At 8.37, with a hazy cloud to N., six observers, in five minutes, counted 553. At 8.45, in fifteen minutes, one observer counted 528 while facing S.E.

A very few, among so many, left visible streaks of light after the meteor itself had disappeared, fifteen seconds being the longest time any of them remained visible. They appeared to radiate from a point a little to the south of μ Cassiopeia, many in the vicinity of that star having courses of less than a degree in angular measurement.

Towards 10 P.M. clouds covered the greater part of the sky, so that only unusually brilliant meteors could be seen; they were, however, again visible, but in decreased numbers, at 11.30.

Birkenhead, Nov. 29 G. H. H.

A VERY well sustained shower of meteors was observed here and at many other stations in the early part of Wednesday evening last, Nov. 27. Unfortunately, however, the weather was very unfavourable for observation at this city, and but very few of the meteors constituting the "shower" came under my notice. The first shooting star was noticed at 5h. 50m. It was a very brilliant one, and must have equalled Venus when at her *maximum*. This meteor passed down the northern sky near Dubhe, in Ursa Major, and left sparks in its flight. Very soon afterwards—at about 5h. 55m.—four other bright meteors, succeeding each other very rapidly, were visible. The most remarkable fact in connection with them was the great coincidence in their apparent courses among the stars. They all *appeared* to diverge from a point westward a few degrees from Polaris, and passing downwards became extinct in Ursa Major. At 6h. 5m. I commenced a careful watch of the sky in conjunction with a friend, and during the interval from that time until 6h. 30m. seventy-four additional meteors came under our observation. At 6h. 30m. the sky was much overcast, and though all the stars were invisible, yet for a short time subsequently I saw several flashes of light in some portion of the heavens, which must have been originated by the bursting of meteors of considerable magnitude. During the time that I was enabled to witness the appearance of meteors, the sky was very much obscured by clouds and mist which rendered nearly all the stars imperceptible. I could, however, faintly see Polaris, Vega, α and β Persei, δ and α Cassiopeiæ, and γ Andromedæ, and was enabled from the paths of the various meteors seen, to find the exact situation of the radiant point. This was situated at a place between Perseus and Andromeda, and about 5° north of the brilliant star Almaach (γ) in the latter constellation. This is at Right Ascension 1h. 56m. Declination 46° North. I saw several meteors in close proximity to this point. They had very short paths. I also noticed two meteors which were apparently quite stationary, and after brightening disappeared. The largest that were seen passed between Ursa Minor and Ursa Major, and several were also noticed in the neighbourhood of α Lyræ (Vega). No shooting stars were seen in the western sky, as it was overcast. I did not notice any trail of light after the disappearance of any of the brightest meteors, nor did I hear any noise as of an explosion, subsequently to the extinction of any one of them. I principally directed my attention to the accurate determination of the radiant point, and to the numbers of meteors visible.

It may be considered remarkable that such a comparatively small number of shooting stars should have come under observation at this city. The facts are, that, owing to the extremely cloudy state of the atmosphere, only an exceedingly small proportion of the meteors which actually existed were seen. During the whole time of observation—*i.e.*, from 5h. 50m. to 6h. 30m., a period of 40m.—it was very cloudy and misty, and but few of the brighter stars were visible, and these were hardly discernible. Under these circumstances, then, it is evident that only the brighter class of meteors could have been perceptible, while the smaller ones, which constituted the great majority of those seen at other stations, must have been utterly invisible. From these facts, I believe that no meteor less in apparent brightness than a second-magnitude star was seen here. Under more favourable atmospheric conditions, no doubt, the meteor shower would have been a grand spectacle from this place, and have equalled in intensity the display as described by other observers at different stations.

It does not seem improbable that the recent exhibition of November meteorites was originated by the earth passing through the node of the periodical comet of Biela. It has been discovered quite recently that an analogy exists between the orbits of comets and meteoric showers; but in reference to this interesting part of the subject I would, however, without occupying further space, direct attention to a paper by Prof. Alexander S. Herschel, which appears in the monthly notices, R. A. S., vol. xxxii. No. 9.

Several correspondents describe an aurora borealis visible on the 27th; and it may be appropriate to note here that a very brilliant display was witnessed at Bristol on the 24th, at about 3 A.M. It was very intense at that time. On the previous and subsequent nights lightning was very frequent, and meteors more numerous than usual. WILLIAM F. DENNING

Bristol, Nov. 30

THERE was a magnificent meteor-shower here on the evening of Wednesday last, the 27th. My attention was first called to it about half-past five o'clock, and I watched it at intervals until about seven, when the sky became overcast with clouds. It really was a shower, and no mistake, the sky at times quite sparkling with meteors. Their point of origin appeared to be in the neighbourhood of Cassiopeia, and their general direction towards the west and north, though several radiated to the east and south. Some, after becoming invisible, as if passing behind some intervening cause, suddenly emerged in all their brightness and then suddenly vanished. The streak left behind was in some instances a continuous, smooth line, in others the appearance was that of a row of sparks strung together. The finest meteor, and the one of longest duration, that I noticed became visible near Cygni, and continued its course to a point a little to the south of Vega. It resembled a small rocket. On the following evening the sky was too overcast to make observations. THOMAS FAWCETT

Blencowe School, Cumberland, Nov. 30

THE splendid meteor-shower of November 27 was well seen at St. Andrews. My attention was not called to it until after the meteors had begun to decline in frequency; but they were still at about 8h. 30m. G.M.T., so numerous as to give considerable confidence in assigning their radiant point, about which they were seen shooting out in all directions. I saw at least two, whose paths were foreshortened almost to a luminous point. These appeared very close to the radiant near two stars in the right foot of Andromeda, which in the maps of the Society for the Diffusion of Useful Knowledge are numbered 51 and 54, or in about R.A. 25°, N. Decl. 48°. The sky became overcast; but about 11h. 30m., meteors were still falling in directions which confirmed my previous estimate of the position of their radiant. The sky was again clear at 1h. 30m. A.M., but I saw no more meteors.

I have since seen, in a table by Schiaparelli, from observations by Zerzioli, 1867-69, and under the date November 30, a radiant point in R.A. 17°, Decl. 48°, which agrees closely with that which I have ventured to assign to the remarkable shower of November 27. W. SWAN

St. Andrews, Nov. 30

Metamorphosis of Insects

THE description of the development of the Lepidopterous wings, and the illustrations which were included in my lecture on Insect Metamorphosis, were taken from Landois' admirable essay in Siebold and A. Kölliker's *Zeitschrift* (1871).

Nov. 25 P. MARTIN DUNCAN

PRIZES OF THE FRENCH ACADEMY OF SCIENCES

AT its annual public meeting on Nov. 25 last the French Academy of Sciences awarded its prizes for the years 1870 and 1871. M. Faye gave a brief introductory address, in which he touchingly alluded to the misfortunes to science arising from the late war, to the various preparations for the forthcoming transit of Venus, the metric commission, and other matters of scientific interest. It is on account of the war that at this annual meeting the Academy had to award prizes for two years, namely, for 1870 and 1871. The list of prizes was as follows:—

Competition of 1870.—1. The Grand Prize in the mathematical sciences this year was offered for a paper on the modification which light undergoes in its mode of transmission and in its properties, in consequence of the movement of the luminous source and the movement of the observer. This prize was not awarded, but a bonus of 2,500 francs was given to M. E. Mascart.

2. The Poncelet Prize was awarded to M. C. Jordan for his treatise on Algebraic Substitutions and Equations.

3. The Dalmont Prize was gained by M. Maurice Levy for his four memoirs on (1) Running Water, (2) The Pressure of Earths, (3) The Interior Movements of ductile Solids, (4) Curvilinear Co-ordinates.

4. The Lalande Prize in Astronomy to Mr. Huggins, for his Discoveries on the Physical Constitution of Stars, Nebulæ, Planets, and Comets. The Commissioners for this prize speak in the highest terms of Mr. Huggins' discoveries, declaring that they mark a brilliant epoch in this new branch of science.

5. The Montyon Prize in statistics, to M. A. Potiquet for his work entitled, "L'Institut de France, &c.;" and honourable mention was made of M. A. Thévenot for the agricultural part of his work entitled "General Statistics of the Canton of Ramerupt," and to M. A. Castan for his memoir on the Influence of Temperature upon Mortality in the City of Montpellier.

6. The Jecker Prize.—MM. Clermont, Gal, and Grimaux, each obtained, by way of bonus, the sum of 1,700 francs for their works on Organic Chemistry.

7. The Barbier Prize was awarded to M. Personne for his Researches upon Chloral.

8. The Desmazières Prize to M. de Notaris for his work entitled "Epilogo della Briologia Italiana"; while honourable mention was made of M. C. Roumeguère for his work entitled "Cryptogamy Illustrated; or, History of the Natural Families of the Acotyledonous Plants of Europe."

9. The Thoré Prize to M. J. C. Schiödte, for his work upon the Metamorphoses of the Coleoptera.

10. The Bordin Prize, for the Comparative Anatomy of Annelids, to M. Léon Vaillant for his works on that subject.

11. The Savigny Prize was divided between M. Issel for his work entitled "The Malacology of the Red Sea" (Italian), and Mr. MacAndrew for his researches into the Malacologic Fauna of the Red Sea.

12. The Bréant Prize. The reward of 5,000 francs, the whole of the annual interest of the legacy, was divided between M. Grimaud (of Caux), for his Researches concerning the Transmissibility of Cholera, and M. Thalorzan, for his work entitled "New Origin of Asiatic Cholera." Honourable mention was made of M. Bourgogne, jun., for his work entitled "Cholera Epidemic in the Communes of Condé, Vieux-Condé, Fresnes, and Escaupont, during the year 1866.".

13. The Chaussier Prize, to M. Tardieu, for his works on Legal Medicine.

14. The Montyon Prize in Medicine and Surgery. Two prizes of 2,500 francs were awarded—(1) To MM. Lancereaux and Lackerbauer for their treatise on Pathological Anatomy; (2) To Dr. Chassagny, for his work entitled "Method of Continued Tractions. The forceps considered as an agent of prehension and traction." Bonuses of 1,200 francs were given—(1) To MM. Colze and Feltz, for their researches into Infectious Maladies, &c.; (2) To M. Jousset, for his experiments upon the Poison of the Scorpion; (3) To M. Decaisne for his memoirs upon the Temperature of Sick Children, and on the influence of Alimentation upon the composition of Female Milk; (4) To M. Despies, for his work on Ulceration and the Ulcers of the Neck of the Uterus. The works of M. V. Famouze upon the Spectra of Absorption of the Blood of M. Bergeret, on the Changes of the Urine, and of Bile in various Diseases, were honourably mentioned.

15. The Godard Prize was awarded to M. C. Mauriac for his work entitled "Essay on the Reflex Symptomatic Neuralgias of Blenorrhagic Parastatitis."

16. The Montyon Prize, in Experimental Physiology, to M. J. Raulin, for his Chemical Studies on Vegetation.

17. The Montyon Prize, for a paper on Unhealthy Occupations, was awarded to M. Guibal for his System of Ventilation applied to the Airing of Mines.

18. The Gegner Prize to M. Duclaux.

19. The Tremont Prize to M. Leroux, who will hold it for three years.

20. The Laplace Prize was obtained by M. H. B. X. Bou-

iron, who held the first place in the Polytechnic School in 1871, and who has entered the School of Mines.

1871.

1. The Poncelet Prize, in Mechanics, to M. J. Boussinesq.

2. The Lalande Prize in Astronomy to M. Borelly for the Discovery of the Planet Lomia.

3. The Montyon Prize in Statistics to M. E. Cadet, for his work on "Marriage in France." Honourable mention was given to Dr. Ely for his work on "The Army and the Population."

4. The Jecker Prize in Chemistry to M. Schutzemberger for his works on Organic Chemistry.

5. The Barbier Prize in Botany to M. Duquesnel, for his memoir on "Crystallised Aconitine."

6. The Bordin Prize for a paper on "The part played by Stomata in the Functions of Leaves," was not awarded, and is withdrawn from competition; but a bonus was given to M. A. Barthelemy.

7. The Desmazières Prize was not awarded either, but a bonus of 500 francs was given to M. Husnot for various works on the Cryptogamic Flora of Martinique.

8. The Bréant Prize.—A sum of 5,000 francs, the whole annual interest of the legacy, was awarded to M. Chauveau for his experiments upon Virulent Virus and Maladies.

9. The Montyon Prizes in Medicine and Surgery.—Two prizes of 2,500 francs were awarded—(1) To M. Grehant for his Physiological and Medical Researches on the Respiration of Man; (2) To M. Blondlot, for a series of memoirs concerning the disputed questions of Medicine, Chemistry, and Physiology. Three sums of 1,500 francs each were awarded—(1) To M. Bérenger-Féraud for his work entitled "Treatise on the Direct Union of Osseous Fragments in Fractures;" (2) to M. Duclout for his work entitled "Account of three cases of Vesico-vaginal fistula," &c; (3) To M. Leon Colin for his Treatise on Intermittent Fevers. Honourable mention was made of (1) M. Raimbert, (2) M. Bucquory, (3) M. Hajem, (4) MM. Krishaber and Peter.

10. The Godard Prize to Mr. J. Jolly for his work on Cancer of the Prostate; honourable mention being made of M. Puech.

11. The Montyon Prize in Experimental Physiology was divided between M. Chantran for his Observations on the Natural History of Crabs, and M. A. Gris for his Memoir on the Pith of Ligneous Plants. Honourable mention was given to M. Mehay for his Essay on Beet-Root Sugar, and a bonus to MM. Cheron and Goujon for their Researches on the Functional Properties of the Nerves and Muscles during the intra-uterine life.

12. The Montyon Prize for Works, &c., bearing on unhealthy occupations. Of this, 2,500 francs were awarded to M. Goldenberg for the methods adopted by him for securing the healthiness of his Manufactories. A bonus of 2,000 francs was given to Mdlle. C. Garcin and to M. Adam for their Automatic Sewing Machine; and a similar sum to M. Louvel for his process of preserving grains *in vacuo*.

13. The Tremont Prize was awarded in 1869 to M. Le Roux, who holds it for three years.

14. The Laplace Prize was awarded to M. L. A. E. Sauvage, dux in 1870 of the Polytechnic School, and who has entered the School of Mines.

MRS. SOMERVILLE

MARY SOMERVILLE (born Fairfax), long ago known for her scientific researches and long well known for her popular and educational scientific works, died in the neighbourhood of Naples, where she has lived for some years, on Friday, November 29, aged nearly 92 years, having been born on December 26, 1780. She belonged to a good Scotch family, her father having been the late Vice-Admiral Sir William George Fairfax, was a great reader, learned Euclid surreptitiously while quite a girl, and at the same period got up a knowledge of Latin in order to be able to read Newton's *Principia*, and was educated at a school in Musselburgh, near Edinburgh.

Her first important contribution to science was made in 1826, when she presented to the Royal Society a paper on the magnetising powers of the more refrangible solar rays, the object of which was to prove that these rays of the solar spectrum have a strong magnetic influence. This paper led to much discussion, which was not set at rest till the researches of Riess and Moser showed that the action upon the magnetic needle was not caused by the violet rays.

Mrs. Somerville's first work of any extent was her "Mechanism of the Heavens" (1831), written at first at the request of Lord Brougham, as one of the series of publications by the Society for the Diffusion of Useful Knowledge. As, however, the work was on too large a scale, and, according to Sir John Herschel, to whom the MS. was submitted, as it was written for posterity, and not for the class whom the society designed to instruct, it was published as an independent work, eliciting from all quarters the highest encomiums, especially as being the work of a woman. It was founded to some extent on La Place's treatise, though the authoress exercised her own judgment in the acceptance or rejection of his theories.

Her next work "On the Connection of the Physical Sciences," was published in 1834, and was referred to by Humboldt as "the generally so exact and admirable treatise."

In 1848 appeared the work by which, perhaps, she is most generally known, her "Physical Geography," which, along with some of her other works, has passed through many editions, been reprinted frequently in America, and translated into several foreign languages. Notwithstanding the numerous works on the same subject that have since appeared, Mrs. Somerville's book still holds place as a first authority, even with the initiated.

In 1869 appeared her last work, "On Molecular and Microscopic Science," which, to quote a writer in the *Edinburgh Review*, "contains a complete conspectus of some of the most recent and most abstruse researches of modern science, and describes admirably not only the discoveries of our day in the field of physics and chemistry, but more especially the revelations of the microscope in the vegetable and animal worlds." The fact that Mrs. Somerville was close on her 90th year when she published this work, in which is contained a *résumé* of the most interesting results of recent scientific investigations, may give one some idea of the undying vigour and clearness of her mind, as well as of her intense love of science.

So long ago as 1835 Government recognised Mrs. Somerville's great merits, by bestowing upon her a literary pension of 300*l.*; and in the same year she was made an honorary member of the Royal Astronomical Society, the only other lady on whom this honour was conferred having been Miss Caroline Herschel. The Geographical Society awarded Mrs. Somerville the Patron or Victoria Medal in 1869, and about thirty years earlier the Fellows of the Royal Society subscribed for her bust, which was executed by Chantrey, and now adorns the Society's library. She certainly deserved all the honours she obtained, for during her long life she has done very much to raise the standard of scientific text-books, and to spread among general readers the accurate results of scientific research.

Dr. William Somerville was his wife's second husband, her first husband having been Captain Greig, a naval officer, fond of mathematics, and who took pleasure in giving his wife instruction in his favourite subject, thus probably giving her mind a bent towards science which has led to important results.

NOTES

ONE of the most cheering Ministerial outcomes that we have read for a long time is to be found in Mr. Gladstone's speech, on Tuesday, at the Society of Biblical Archæology, an outcome which indicates, we take it, on the part of the Government, that the lamentable condition of research in England has at length forced itself upon them, and that the policy which has done such an infinity of harm, and the fruits of which we are reaping, is at length to be reversed. In the speech to which we refer Mr. Gladstone said :—"I do not at all deny that many fields of inquiry have been so much widened and deepened of late years, that it is both becoming and proper for the Government from time to time, according to circumstances and occasions, to take part in, and give encouragement and assistance to, those things, many of which indeed cannot be prosecuted without that assistance." The paper read at the meeting to which we refer was one by Mr. G. Smith on a Chaldean account of the Deluge which he has recently deciphered. This communication was of such high importance that we hope to be able to refer to it at length next week.

THE next meeting of the British Association for the Advancement of Science will be held at Bradford, not on September 19, 1873, as was fixed at the Brighton meeting, but for the convenience of many who have objected to the date, a fortnight earlier than that time. The Vice-Presidents appointed are Earl Rosse, Lord Houghton, Mr. W. E. Forster, M.P., and the Mayor of Bradford (Mr. Thompson). At Bradford an executive committee of sixteen persons, and also a larger general committee have, as usual, been appointed to prepare for the next meeting of the Association, and a public subscription, which is not to be less than 4,000*l.*, has been opened, for the purpose of defraying the estimated expenses in connection with the visit of the Association to the town. Of this sum 1,500*l.* will be required for the erection of a temporary building as a reception room. At a meeting held the other night 1,000*l.* were contributed on the spot, including 250*l.* by the Mayor.

AT the recent second M.B. examination at the University of London, the Scholarship and Gold Medal in Medicine were awarded to Mr. B. N. Dalton, of Guy's Hospital, the Gold Medal in Medicine to Mr. W. Ottley, of University College, the Scholarship and Gold Medal in Obstetric Medicine to Mr. Robert Eardley Wilmot, of King's College, the Gold Medal in Obstetric Medicine to Mr. W. C. Greenfield, of University College, the Gold Medals in Forensic Medicine to Messrs. M. Harris, of Guy's Hospital, and W. Ottley, of University College.

THE Brakenbury Natural Science Scholarship at Balliol College, Oxford (80*l.* per annum for four years), has been awarded to Mr. R. B. Don, of Clifton College. No fewer than four other scholarships in Natural Science have already been gained during the present year by boys from Clifton College, viz., two at St. Peter's College, Cambridge, one at Christ College, Oxford, and one at Magdalen College, Oxford.

VICE-CHANCELLOR BACON has decided that the conditions of the legacy under which sums of money were left by the late Mr. James Yates to endow the Professorship of Mineralogy and Geology at University College, and to found a Professorship of Archæology at the same college, have not been fulfilled, and that the legacies have therefore reverted to the heir-at-law of Mr Yates.

IN accordance with the anticipation we have already expressed, Dr. Macalister has been chosen to fill the newly-founded chair of Comparative Anatomy at Trinity College, Dublin. Dr. Macalister continues to hold the Professorship of Zoology in the University of Dublin.

MR. J. A. WANKLYN has, according to the *Chemical News*, become a candidate for the Chemical Prælectorship at Cambridge.

MR. E. G. PITT has been appointed Medical Officer of the south district of St. George's-in-the-East.

MR. BASS has presented Derby with 5,000*l.* towards the erection of a free library.

A MADAME DE PERINOT has left to the French Academy of Sciences a legacy of 20,000 francs for the foundation of a prize, to be awarded every two years, for the purpose of assisting astronomers and encouraging astronomical researches.

THE two Actonian prizes of 105*l.* have been awarded by the Managers of the Royal Institution to the Rev. George Henslow and to Mr. B. Thompson Lowne, for "Essays on the Theory of the Evolution of Living Things."

THE Baroness Burdett Coutts' prize for the best essay on the Isochronism of the Balance-spring was divided by the adjudicators equally between Mr. Palmer, of Leominster, and Mr. Moritz Immisch, of Regent Street, neither taking precedence of the other.

IT is satisfactory to learn that 116 citizens of New York have lately tendered to Mr. B. Waterhouse Hawkins an expression of their sympathy with him in his grief at the loss of his models of the gigantic fossil reptiles of North America, which were broken to pieces and carted off as rubbish by order of certain unenlightened officials of the public parks, as mentioned in NATURE some time ago. Mr. Hawkins has presented some casts of the pelvic and other bones of *Hadrosaurus* (one of the most interesting of these restorations) to the Museum of the Royal College of Surgeons.

THE new Medical Microscopical Society will meet at 8 P.M. on December 6, in the college dining hall, St. Bartholomew's Hospital, to sanction rules, elect officers, and receive names of intending members, &c.

MESSRS. L. REEVE and Co. announce a new and important part of Bentham and Hooker's "Genera Plantarum" at the commencement of the new year. It will include Dipsacaceæ, Valerianaceæ, Compositæ, and Rubiaceæ.

WE have received from Mr. Quaritch, of Piccadilly, a list of very valuable books he has for sale from the libraries of the late Dr. Robert Wright, F.R.S. late of Madras, of the late Prof. Babbage, of the late Mr. G. R. Gray, F.R.S. of the British Museum, and the library of an architect.

THE official Report of the Proceedings of the Meteorological Conference at Leipzig in August last will appear in the Journal of the Austrian Meteorological Society, and is now in the press. A translation is being prepared by Mr. Robert H. Scott, and will be issued under the authority of the Meteorological Committee as soon as possible after the appearance of the German original.

WE have received the first number of the *Telegraphic Journal*, whose expected appearance we announced some time ago, and to judge from the prospectus to the first issue, it promises to perform good services to the scientific and industrial department with which it is connected. From one paper we learn that the total number of marine cables laid is 213, measuring 43,783¼ miles.

WE have received from the United States Government copies of their official tri-daily weather-map and bulletin, containing the result of meteorological observations taken simultaneously at about eighty stations.

WE learn from the *Photographic News* that Dr. Vogel, the President of the Berlin Society for the Advancement of Photography, and instructor in the art at the Royal Industrial College, has been made a Professor. Thus we have the first instance of the appointment of a Professor of Photography, and we heartily join the German photographers in their congratulations on the chair being so worthily filled. Dr. Vogel is about to publish a photographic dictionary.

VE learn that Part xi. of "Reliquiæ Aquitanicæ" is in the ss. This serial work, descriptive of the Caves of Perigord l their contents, has been interrupted of late by the death of E. Lartet and the disturbances in France. The executors l friends of the late Henry Christy are proceeding with the rk as expeditiously as possible, but do not expect to produce te as many parts as originally contemplated.

ΓHE *School Board Chronicle* tells us that an international lege such as appears to have been the ideal of Mr. Stuart ll has existed for some time in the Canton of Zurich. This is : Institution Breidenstein, in which there are at present as ıny as eighty-eight pupils, representing fourteen different tions from the two hemispheres. These scholars speak nine fferent languages between them.

WE have received the last three numbers of the *Horological ›urnal*, and, judging from its contents, it seems well calculated accomplish one of its chief purposes, to spread a knowledge the scientific principles upon which the art of watch and ock making is founded. It well deserves the support of all ıose for whose benefit it is intended.

CONSIDERABLE changes, says the *Quarterly Meteorological Journal*, are in progress in the meteorological organisations of arious countries. In France, M. Jules Simon has reversed he action of the Imperial Government, and placed the entire neteorological system under the Observatory of Paris. The Observatory of Montsouris, which C. Ste.-Claire Deville had established with much care, has been placed under the Observatory, and most of the meteorological work of the latter establishment has been transferred to it. The *Bulletin International* is now dated from Montsouris, but the series of observations at the Paris Observatory has not been suspended. M. C. Ste.-Claire Deville has been appointed Inspector-General of all the French Meteorological Stations, except those in connection with the telegraphic system. In Denmark, Captain N. Hoffmeyer has been placed at the head of the newly organised Institute. In Sweden, the intention of the Government to establish a central Institute in Stockholm in the year 1873 is announced, and the Observatory at Upsala is to be the central station. In Berlin arrangements are reported to be in progress for the founding of a more complete meteorological organisation than that now existing, which is of old date, and is in connection with the Statistical Bureau.

Harper's Weekly announces the death, at Reading, Pennsylvania, at the age of fifty-six, of Mr. William M. Baird, a gentleman who was much interested in natural history, and especially in ornithology. Mr. Baird, while residing at Carlisle, Pennsylvania, commenced in 1838 a collection of the birds of the county, in which he was assisted by his younger brother, Prof. S. F. Baird, of the Smithsonian Institution; and the two carried on their labours in common for many years, during which time they published conjointly descriptions of two new species of small fly-catchers discovered by them in the vicinity of Carlisle, as also a list of the birds of Cumberland County. Having adopted the profession of the law, Mr. William Baird was obliged to give up his active labours in ornithology, and the work was continued by his brother, who, on receiving an appointment in connection with the Smithsonian Institution at Washington, carried to it the conjoint collection, which formed, in a measure, the basis of the magnificent series of North American birds in the institution, and which has served as the material for so much research on the part of naturalists in America and other countries.

ON November 26, the first Annual General Meeting of the National Union for improving the Education of Women of all classes was held at the rooms of the Society of Arts, Lord Lyttelton in the chair. The two principal resolutions were that "the meeting, feeling the inadequacy of the supply of good schools for girls, pledges itself to promote the establishment of such schools, and also to aid all measures for extending to women the means of higher education beyond the school period of life; and that the meeting, feeling the necessity of thorough training for teachers, and of some recognised test of their efficiency, pledges itself to promote measures for the attainment of those objects." The grand principle upon which the Union is founded, is "that the human faculties and intellect have been impartially given, and belong in equal degree to both men and women."

WE notice that a new method of lighting gas has been invented by Mr. J. Billington Booth, of Preston, the working of which was shown by him the other night in that town. By this method the whole of the street lamps can be lighted simultaneously from any distance. The apparatus constituting the invention, the *Preston Chronicle* tells us, looks like a moderately-sized globular inkstand of glass, surmounted by a tube of the same material, with a metallic top; by screwing off the burner it can be very easily attached to any lamp, chandelier pipe, or ordinary gas-jet. The base or globular portion is filled with a deep red-coloured liquid, so cheap that three pennyworth will serve the lamp for a year. Over the liquid and within the glass tube there is a plate of zinc, with a piece of graphite or gas coal, and between these and a thin coiled platinum wire, fixed over the cup of the general vessel, into which a gas-burner is inserted, galvanic communication is obtained. Ignition is thus effected: A pipe is screwed to the top of the gaspipe; pressure on the gas in this pipe causes a simultaneous depression upon the chemical solution which occupies a lower level in two side tubes; the gas occupies the vacuum caused by the displaced liquid, and then ascends to a chamber connected with the burner, while the displaced liquid is pressed into two side-tubes effecting contact with the zinc and graphite, and generating galvanic activity. This is communicated to the platinum wire, and excites its catalytic power; the wire being then exposed to the ascending jet of gas, immediate ignition takes place.

AN invention by Mr. J. A. H. Ellis, of Boston, U.S., is described in the *Industrial Monthly*, by means of which, it is said, enormous amount of heat wasted in exhaust steam is profitabl utilised. The method consists in passing the exhaust steam from an ordinary steam-engine through the tube of a boiler filled with the bisulphide of carbon (which boils at 110° Fah.), in the same way that smoke and the products of combustion are passed through a steam-boiler filled with water. The result is, according to our authority, that the bisulphide boiler will be rapidly heated up to 212° Fah., the resulting vapour being able to keep an engine going, and do a large amount of work, if the supply of exhaust steam is sufficient. By this means one large steam-engine might keep not only itself going, but supply the necessary power to a number of neighbouring small ones, the latter being thus able to dispense with fire and all attendance. The *Industrial* says the method is actually at work at Fitchburg, Massachussetts.

FROM the *British Medical Journal* we learn that at the last examination in anatomy held at the University of Berlin, two candidates alone, amongst the thirteen who presented themselves, obtained the notice "good." One of these was a Japanese medical student called Sasumi Satoo. The intellectual labour and the amount of perseverance necessary to gain this success will be appreciated when it is known that in November 1869, the time when Sasumi Satoo was sent by his father to Berlin, he did not even know the German characters. The first five months he applied himself exclusively to the study of German, and he acquired in the remaining six months the knowledge of all the subjects, including Latin, which were required for the first examination. The father of Sasumi is the principal physician to the Mikado, and enjoys in Japan great celebrity as an operator.

THE BIRTH OF CHEMISTRY

V.

The Alchemists.—Origin of Alchemy.—Hermes Trismegistus.—Greek MSS. on Alchemy.—Their probable authorship and age.

WE speak here of the alchemists almost for the first time, and we must now turn our attention to the origin and growth of their dogmas, and to their work. We have already seen that the word χημεία is first found in the Lexicon of Suidas, and that he defines it as "the preparation of gold and silver." He further tells us, under the same heading, that the books on the subject were sought for by Dioclesian and burnt, lest the Egyptians should become rich through their knowledge of the art, and should thus be able to resist the Romans. Now, the people who professed a knowledge of the art of making gold were called *alchemists.* The word *alchemy,* as we have previously shown, consists of a Coptic root united with an Arabic prefix, and signifies the *hidden* or *obscure art.* Alchemists were those who practised this mysterious art. We can well understand why the professors of such an art should maintain the utmost secrecy; to divulge such magic would be to make all men equally rich; hence it was necessarily a hidden art. Neither did the books on the subject avail much, for they are filled with some of the most incomprehensible nonsense that ever was written. Yet the literature of the subject is enormous. The volumes on alchemy in our large libraries are to be counted by the hundred. In 1602 Zetzner published, in Strasburg, a "Theatrum Chemicum," containing more than a hundred tracts on alchemy, selected from various notable authors. A century later Mangetus published his "Bibliotheca Chemica Curiosa," in two large folios, containing a hundred and twenty-two alchemical treatises. We have previously given the titles of a few Greek MSS. on alchemy. The list has been extended to eighty-three. Arabic and Persian MSS. on the subject are not uncommon. There are treatises in Spanish, Italian, German, Dutch, and English on alchemy, and, more numerous than all, treatises in Latin, in every large library. Let us endeavour to get from the tangled mazes of this hieroglyphical literature, some idea of alchemy, and of its influence upon chemistry.

We are, perhaps, puzzled at the outset to comprehend how any one man, much less thousands of men, could have deluded themselves with the belief in the possibility of transmuting one kind of matter into another:—crude lead, or tin, or mercury, into weighty, lustrous gold. But this was not the greatest wonder of the age. At the time when alchemy arose, and throughout the period during which it most flourished, the belief in theurgy, witchcraft, necromancy, and magic of all kinds was rife among all classes; and surely it was less wonderful to change lead or tin into gold, than to call up the spirit of one's ancestor, or to confer perpetual youth upon a nonagenarian! It is, for wonderment, as compared with the greater magic of the day, as the process for the conversion of benzine into aniline compared with spirit-rapping; or as a demonstration of specific inductive capacity compared with a manifestation of psychic force. Alchemy was considered to be perfectly rational not two centuries ago, and was among the lesser forms of magic, inasmuch as it did not require the influence of supernatural causes.

The growth of the idea is not difficult to trace. The ancients had persistently asserted the change of one element into another. Thales, as we have seen, evolved the ten thousand forms of nature and kinds of matter, from water, Anaximenes from air, by successive transmutation. Aristotle, whose physical views were accepted without question by the alchemists, had endeavoured to show by clever argument that, if you transfer a quality of water to fire, you obtain air; while if you transfer a quality of earth to air, you get water; and so for fire and earth, and that from these elements all things proceed. This was readily accepted by Middle Age thinkers. The alchemists reasoned, plausibly enough:—if fire becomes air, air water, and water earth, why may not one kind of substance formed from these elements be changed into another kind of substance of somewhat the same nature, and certainly more similar than air and water, or water and earth? Why may not lead, compounded of these elements in certain proportions, be changed into gold, compounded of these elements in certain other proportions? There have been falser modes of reasoning than this in the history of science.

Let the ancient Greek theory of the transmutation of the elements be once literally accepted, and the alchemical belief in transmutation follows naturally; it is a minor application of the major proposition. There is nothing to wonder at in this; the human mind seldom moves by fits and starts; an essentially new mode of thought and new form of belief is rare, and many apparently new dogmas are united with older dogmas in the closest manner, and are in fact direct emanations from them. Such was the alchemical idea of transmutation. Admitting the possibility of the process, a man would naturally ask himself "What do I most desire to make?" What in this world procures the greatest amount of happiness, and of power?" For what have men slaughtered each other by the thousand in open war, or singly and secretly in the dead of night? For what have kingdoms been sold, great tracts of land ceded, and people been ground into serfdom till they rose and rioted against their oppressors? For what have princes and cardinals been created, emperors and kings destroyed, and the eternal peace of troubled souls promised? In a word, for what will man dare all things, sacrifice all things; for what will he toil during a lifetime; to what will he devote all his intellectual energies? This is surely the thing for the ready acquirement of which we may devote much time and thought, and this thing is *gold.* This is the key to the prodigious masses of alchemical literature, and to the mysteries and anomalies connected with men who often wasted their whole lives and all they possessed in the endeavour to change baser metals into gold.

If we consult alchemical MSS., no matter the date or author, or language, we find constant mention of Hermes Trismegistus, who was indeed considered, and sometimes designated, the *father of alchemy.* In a treatise attributed to Albertus Magnus we are told that the tomb of Hermes was discovered by Alexander the Great, in a cave near Hebron. In this was found a slab of emerald which had been taken from the hands of the dead Hermes by Sarah, the wife of Abraham, and which had inscribed upon it in Phœnician characters the precepts of the great master concerning the art of making gold. The inscription consisted of thirteen sentences, and is to be found in numerous alchemical works. It is for the most part quite unintelligible, and in style closely resembles the great mass of Middle Age alchemical literature.

The following is cited as the inscription of the "Smaragdine Table," and is to be found in very early MSS. in various languages:—

1. I speak not fictitious things, but that which is certain and most true.
2. What is below is like that which is above, and what is above is like that which is below, to accomplish the miracles of one thing.
3. And as all things were produced by the one word of one Being, so all things were produced from this one thing by adaptation.
4. Its father is the sun, its mother the moon; the wind carries it in its belly, its nurse is the earth.
5. It is the father of all perfection throughout the world.
6. The power is vigorous if it be changed into earth.
7. Separate the earth from the fire, the subtle from the gross, acting prudently and with judgment.
8. Ascend with the greatest sagacity from the earth to heaven, and then again descend to the earth, and unite together the powers of things superior and things inferior. Thus you will obtain the glory of the whole world, and obscurity will fly far away from you.
9. This has more fortitude than fortitude itself; because it conquers every subtle thing and can penetrate every solid.
10. Thus was the world formed.
11. Hence proceed wonders, which are here established.
12. Therefore I am called Hermes Trismegistus, having three parts of the philosophy of the whole world.
13. That which I had to say concerning the operation of the sun is completed.

The story and the inscription, together with all books attributed to Hermes, are no doubt the production of monks of the Middle Ages, albeit they are attributed to Hermes, who is asserted to have lived about 2000 B.C. In spite of the obvious worthlessness of the inscription of the emerald table, men have not been wanting who have laboured long and lovingly to prove its authenticity, to interpret it, and to show that it is in good sooth a marvellous revelation, full of sublime secrets of considerable import to mankind.

Hermes Trismegistus is generally asserted by the alchemists to have been a priest who lived a little after the time of Moses. According to Clemens Alexandrinus he was the author of forty-o books containing all the learning of the Egyptians; others l us that he was the author of several thousand volumes. ato speaks of him in the "Phædrus" as the inventor of numbers d letters. He was in fact the Egyptian god of letters, and as ch of course could be described as the author of multitudinous orks. He was the deified intellect, and hence has often been nfounded with Thoth, "the intellect." Sir Gardner Wilkinson eaks of Hermes as an emanation of Thoth, and as representing the abstract quality of the understanding." The woodcut (Fig. representing Hermes, is from a temple at Pselcis, which was ected by Erganum, a contemporary of Ptolemy Philadelphus. may be well to note the extent of the symbolism associated ith the sculpture; in one hand Hermes holds the *Crux ansata*, e symbol of life, in the other a staff, associated with which are serpent, a scorpion, a hawk's head, and, above all, a circle surounded by an asp, each with its special symbolical signifiance. On the Rosetta stone Hermes is called "the great nd great," or twice great; he was called *Trismegistus*, or hrice great, according to the twelfth aphorism of the emerald able, because he possessed three parts of the wisdom of the whole world, which in his light of deified intellect he might well do.

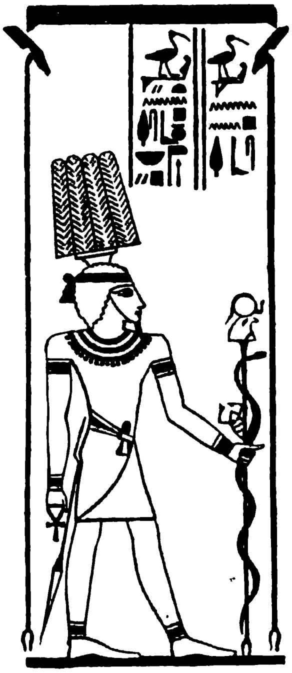


FIG 6.—Hermes Trismegistus; from the Temple at Pselcis.

Perhaps no author is more often quoted by the Alchemists than Hermes, the supposed father of their art. They called themselves *hermetic philosophers*. Alchemy is often called the *Hermetic Art*, or simply *hermetics*. To enclose a substance very securely, as by placing it in a glass tube and fusing, or sealing, the mouth of the tube, was called securing with "Hermes his seal," and the echo of the idea lives amongst us yet; for, in our most modern treatises, the expression "to seal hermetically" may be found.

Petrus Hauboldus, of Copenhagen, was surely one of the most enterprising publishers of his day, for he had the temerity to publish a book entitled, *Hermetis Ægyptiorum et Chemicorum Sapientia*. A book square as to its dimensions, small as to its type, drier than dust as to its contents, of four hundred odd pages, of two centuries of age, writ in Latin, with a sprinkling of contracted Greek, and floridly dedicated to Jean Baptiste Colbert. A book wherein the author endeavours to prove that alchemy was known before the flood, that Hermes Trismegistus was a real personage, the inventor of all arts, the father of alchemy, and much else besides. We may well imagine that the author of such a treatise was no ordinary man, and our conjecture proves a tolerably correct one. Olaf Borch, whose Latinised name because the more resounding *Olaus Borrichius*, was apparently the great mainstay of the University of Copenhagen; at all events, he was simultaneously Professor of Philology, Poetry, Chemistry, and Botany, and we must either imagine that in 1660, professors were difficult to procure in the Kingdom of Denmark, or else that Olaus Borrichius was such an astounding genius that he could readily undertake the duties of four diverse professorships at the same time. We can scarcely imagine three greater antitheses than the philological faculty, the poetical faculty, and the chemical faculty; but here we find them united, or assumed to be united, in one man. Yet more, Borrichius was appointed Court Physician, and Assessor of the Supreme Court of Law. He was the very personification of all learning, if we may judge by the treatment he received from his countrymen. In addition to the work mentioned above, he wrote several on philology, on the quantity of syllables, on the Greek and Latin poets, on medicine, chemistry, and botany. It is strange that a man who, presumably in his capacity of judge, was in the habit of sifting evidence, and of avoiding hasty generalisation, should have endeavoured with much elaborate argument to prove that Hermes Trismegistus was a real personage; that his Smaragdine table was really found by the wife of Abraham, and that it contained matter of the highest import to mankind. We must imagine that in this matter Borrichius allowed the imaginative faculty due to his poetical temperament to exert an undue influence over his more sober judgment. He is equally at pains to assert the authenticity and antiquity of the various Greek MSS. on alchemy in the libraries of Europe. He specially mentions a MS. by Zozimus of Panapolis, on the art of making gold, in the King's Library in Paris; and Scaliger tells us that this same MS. was written in the fifth century. M. Ferdinand Hoefer is apparently penetrated by the Borrichian spirit of faith and imagination, and he unhesitatingly accepts the early date attributed to the Paris MS.

M. Hoefer traces the rise of Alchemy to the fourth century of our era; it was then known as the "sacred art" (*ars sacra*; τέχνη ἱερα), and one of the chief writers on the subject was the said Zozimus of Panapolis. The principal Greek MSS. attributed to Zozimus, which exist in the Bibliothèque Nationale, have the following titles:—(α) On Furnaces and Chemical Instruments; (β) On the Virtue and Composition of Waters; (γ) On the Holy Water; (δ) On the Sacred Art of making Gold and Silver. In the latter, Zozimus mentions that if the "soul of copper," which remains above the water of mercury, be heated, it gives off an aëriform body (σῶμα πνευματίκον), and this (says M. Hoefer) was probably oxygen gas, while the soul of copper was oxide of mercury. A second author of early Greek MSS. was Pelagius, who alludes to two writers named Zozimus—one the "Ancient," the other the "Physician." A third author, Olympiodorus, who calls the "sacred art" chemistry (χημεία), quotes Hermes, Democritus, and Anaximander as alchemists.

Democritus (not to be confounded with the Greek philosopher of that name), in his "Physics and Mystics," informs us how he invoked the shade of his master, Ostane the Mede, and how the spirit appeared and accorded him mystical communings. Synesius, the commentator of Democritus, lived, according to M. Hoefer, about fifty years after Zozimus (say 450 A.D.); but a treatise on the Philosopher's Stone is in existence which claims Synesius as its author, which mentions Geber, who lived at least 400 years later. Mary the Jewess, who is often alluded to by later alchemists, was a contemporary of Democritus, and a writer on alchemy; she also invented various chemical vessels, among others a bath, to gently transmit heat by means of hot sand or cinders, which (according to M. Hoefer) is still called after her, a *Bain-Marie*.

We cannot assign to the Greek MSS. in the Bibliothèque Nationale the antiquity which M. Hoefer and others so readily accept; and we must still hold to our opinion that they and all other known Greek MSS. on alchemy are the production of later centuries, and are probably the work of Greek monks. In the first place, who was Zozimus? Was it Zozimus the Anti-pope, who succeeded Innocent I., or Zozimus the Sophist of Alexandria, or Zozimus the historian? No one can tell. It cannot be pretended that any of the Paris MSS. are in the actual writing of Zozimus. One of them is entitled "Zozimus the Panapolite, on the Chemical Art, to his Sister Theosebia;" but, according to the "Biographie Universelle," it was Zozimus of Alexandria who dedicated books to his sister Theosebia, and he lived in the third century B.C., while Zozimus of Panopolis lived in the fourth century A.D. Here, then, we have a discrepancy of 700 years, and a clear confounding of Zozimus of Alexandria with his namesake of Panapolis. Suidas attributes chemical works to the former, but we must remember that the word χημεία does not occur before the eleventh century, A.D. The director of the Bibliothèque Nationale,* in a recent letter for which we have to thank him, writes as follows :—"La Bibliothèque Nationale ne renferme aucun manuscrit grec de Zosime de Panapolis qui puisse attribué a une époque antérieure au XIII. Siécle. Le plus ancien de ceux qu'elle possède ne remonte pas plus loin que cette date." Everything tends to prove that the MSS. were not only written, but composed at a period posterior to the fifth century. The fanciful titles of some of them show us that their authors adopted any name they pleased; thus we have "the Epistle of Isis, queen of Egypt, and wife of Osiris on the sacred art, addressed to her son Horus," in which we find a solemn oath dictated to Isis by the angel Amnaël, who swears by Mercury and Anubis, by Tartarus, the Furies, and Cerberus, and by the dragon Kerkouroboros. The whole thing is plainly a blending of eastern and western thought: personages of Egyptian, Greek, and Roman mythology, with angels of the Talmud, and genii of Arabic lore. We are glad to find that M. Hoefer breaks freely away from the too confident Olaus Borrichius, as to the authenticity of Hermes Trismegistus. He admits that the books which bear his name are spurious, and concludes that their author, "vivait probablement à l'époque critique du Christianisme triomphant et du paganisme à l'agonie." But if we take this as the time of Constantine the Great, we must venture to attach a later date to these writings.

We recently had an opportunity of examining the MS. in the Bibliothèque Nationale, attributed to Zozimus and to the fifth century; a MS. which, from its frequent mention in both ancient and modern works on the history of chemistry, possesses special interest. It is entitled "Zozimus on Chemical Instruments and furnaces, and on the Holy Water" (*Ζωσίμου περὶ ὀρχάνων καὶ καμίνων καὶ περὶ του θείου ὕδατος*), and it is a well-preserved MS. of the thirteenth century, written on vellum. The few drawings which it contains are asserted to have been taken by the author from a temple at Memphis. The Alembic (*b* in the accompanying woodcut, Fig. 7) is copied from this MS., in which also the line of symbols (*a*) is found. These symbols occurred in almost every Greek MS. on alchemy which we examined, but we could find no clue to the curious porcupine-like animal. The symbol *c* is clearly of astronomical origin, and is not often met with in later works. The MSS. are for the most part devoid of figures, and not so full of symbols as later alchemical treatises.

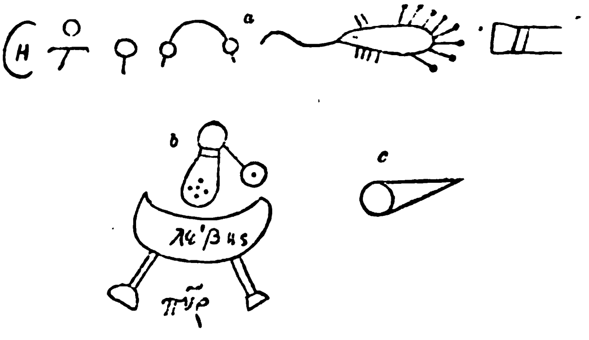


Fig. 7.—An Alembic, and Symbols from Greek MSS. on Alchemy.

We have endeavoured to prove (α) that no reliable date can be assigned to existing Greek MSS. on alchemy, and (β) that the accepted date is too early. Even if we could prove that a man named Zozimus, living in the fourth century, wrote treatises on alchemy, we could not use the existing MSS. for any exact purpose connected with the history of science with safety; for, since we have no such MS. earlier than the tenth or eleventh centuries, it would be quite impossible to determine whether additions had been made during transcription. The facts are simply these:—There exist in various parts of the world Greek MSS. on alchemy, none of which are older than the tenth century. Many of these bear the names of mythical personages of Egyptian mythology, some of ancient Greek philosophers, some of people who are supposed to have lived in the fourth or fifth century, A.D. When we remember that no ancient writer makes mention of alchemy or chemistry, that the word χημεία is first used in the eleventh century, and when we further bear in mind the condition of the intellectual world in the fourth and fifth centuries, we think we may well admit that further evidence is necessary before we can assert that alchemy arose in the fourth century. Indeed we are of opinion that, in spite of all that has been written on the subject, there is no good evidence to prove that alchemy and chemistry did not originate in Arabia not long prior to the eighth century, A.D. G. F. RODWELL

ON THE ECLIPSE EXPEDITION, 1871*

II.

I MUST now state very briefly some of the results of our work; and first, the certain results.

We were able to make out the structure of the corona. We know all about the corona so far as the structure of its lower brighter strata, that portion, viz., which I referred to in my lecture last year as being visible both before and after totality, is concerned. You may define it as consisting of cool prominences; that is to say, if you examine a prominence any day without waiting for an eclipse, and then go to an eclipse and examine the lower portion of the corona, you will find the same phenomena, minus the brightness. You find the delicate thread-like filaments which you are now all so familiar with in prominences—filaments which were first thrown on a screen in this theatre; the cloudy light masses, the mottling, the nebulous structure, are all absolutely produced in the corona, as far as I could see it with a telescope with an aperture of 6¼ inches; and I may add that the portion some five minutes round the sun reminded me forcibly in parts of the nebula of Orion, and of that surrounding η Argus, as depicted by Sir John Herschel in his Cape observations.

We have shown that the idea that we did not get hydrogen above 10 seconds above the sun is erroneous; for we obtained evidence that hydrogen exists to a height of 8 or 10 minutes at least above the sun; and I need not tell you the extreme importance of this determination. One of the proofs we have of that lies in this diagram, showing the observations made by Prof. Respighi, armed with an instrument the principle of which I hope you are now familiar with.

Just after the sun disappeared Prof. Respighi employed this prism to determine the materials of which the prominences which were then being eclipsed were composed; and he got the prominences shaped out in red, yellow, in blue, and in violet light; a background of impure spectrum filling the field, and then as the moon swept over the prominences these images became invisible; he saw the impure spectrum and the yellow and violet rings gradually die out, and then three bright and broad *rings* painted in red, green, and blue, gradually form in the field of view of his instrument; and as long as the more brilliant prominences were invisible on both sides of the sun he saw these magnificent rings, which threw him in a state of ecstacy. And well they might.

These rings were formed by C and F, which shows us that hydrogen extends at least 7 minntes high, for *had we not been dealing with hydrogen we should have got a yellow ring as well*, because the substance which underlies the hydrogen is more brilliant than the hydrogen itself, and in addition to the red ring and the blue ring, which indicate the spectrum of hydrogen, he saw a bright green ring, much more brilliant than the others, built up by the unknown substance which gives us the Kirchhoff line, 1474.

Now at the time that Prof. Respighi was observing these beautiful rings by means of a single prism and a telescope of some four inches aperture, some 300 miles away from him—he was at Poodocottah and I was at Bekul—I had arranged the train of prisms which you see here so that the light of the sun should enter the first prism, and after leaving the last one should er my eye. And what I saw is shown, side by side with spighi's observations, in this diagram, in which I have arated the rings somewhat, so that there should be less conion that in the actual observation. Here is Prof. Respighi's t observation. He gets indications of C, D^3, F, and the drogen line near G. He was observing the very lowest, ghtest region of all, and therefore 1474 was obliterated by the ghtness of the continuous spectrum; but as the eclipse went D^3 was entirely obliterated, and afterwards he got C and F ilding up rings together with 1474, which was not represented the lower regions of the prominence—not because it was not ere, but because, as I have already insisted, of the extreme illiancy of the background. Now my observation was made termediately as it were between the two observations of Prof. espighi's. Let me show the observations together.

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* This library has so often changed its name of late, that we think it necessary to mention that we mean the library in the Rue Richelieu, which is called by old writers the *Bibliothèque du Roi* sometimes the *Bibliothèque Royale*, lately the *Bibliothèque Impériale*, still more lately the *Bibliothèque Communale*, now the *Bibliothèque Nationale*.. Juncker in his *Conspectus Chemiæ*, in speaking of various writers on alchemy cites "Zozimus Panapolites celeberrimus et magni cognomen adeptus, cujus varia scripta exstant in Bibliotheca Regia Parisiensi."

* A Lecture delivered at the Royal Institution of Great Britain, Monday, March 22, 1872, by J. Norman Lockyer, F.R.S. (concluded from p. 58)

Respighi	...	C D^3		F G	Prominences at beginning of eclipse.
Lockyer	...	C	1474	F G	Corona at 80 seconds from commencement.
Respighi	...	C	1474	F	Corona at mid eclipse.

ote that I had no object-glass to collect light, but that I had ore prisms to disperse it; so that with me the rings were not high as those observed by Respighi, because I had not so uch light to work with: but such as they were I saw them etter because the continuous spectrum was more dispersed, and ecause, with my dispersion, the rings—the images of the corona –therefore did not so much overlap. Hence doubtless Respighi issed the violet ring which I saw, so faint, however, that both hat and 1474 were almost invisible, while C shot out with marellous brilliancy, and D^3 was absent.

These observations thus tend to show, therefore, that instead f the element—the line of which corresponds with 1474—existng alone just above the prominences, the hydrogen accompanies t to what may be termed a great height above the more ntensely heated lower levels of the chromosphere, including the prominences in which the lower vapours are thrown a greater height. With a spectroscope of small dispersion attached to the argest mirror of smallest focus which I could obtain in Engand, the gaseous nature of the spectrum, as indicated by its *tructure*, that is, bands of light and darker intervals as distinguished from a continuous spectrum properly so called, was also rendered evident.

These are results of the highest importance, which alone are worth all the anxiety and labour connected with the expedition.

But there is more behind.

The photographic operations (part of the expense of which was borne by Lord Lindsay) were most satisfactory, and the solar corona was photographed to a greater height than it was observed by the spectroscope, and with details which were not observed in the spectroscope.

Mr. Davis was fortunate enough to take an admirable series of five photographs at Bekul, and Captain Hogg also obtained some at Jaffna; but I am sorry to say the latter lack somewhat in detail.

I have prepared two lamps, because I am anxious to exhibit the photographs two at a time, that you may compare one with the other. [This was done.] You see that so far as the camera goes—and mark this well—the corona was almost changeless during the whole period of totality; this is true, not only for one place, but for all the places at which it was photographed.

I now exhibit two other photographs—one taken at Jaffna and the other at Ootacamund. Actinically the corona was the same and practically changeless at all the stations. You see that, though not so obvious as in the other case, there is the same similarity.

Before I leave the actinic corona, I am anxious to show you an image of it, taken during the American eclipse of 1869 in a camera exposed to the sun during the whole of the totality; to a certain extent in our recent photographs we have reproduced what was photographed in 1869.

The solar nature of most, if not all, of the corona recorded on the plates is established by the fact that the plates, taken in different places, and both at the beginning and end of totality, closely resemble each other, and much of the exterior detailed structure is a continuation of that observed in the inner portion independently determined by the spectroscope to belong to the sun.

While both in the prism and the 6¼ inch equatorial the corona seemed to form pretty regular rings round the dark moon, of different heights, according to the amount of light utilised by the instrument, on the photographic plates, the corona, which, as I have before stated, exceeds the limits actually seen in the instrument I have named, has a very irregular, somewhat stellate outline, most marked breaks or rifts (*ignored by the spectroscope*), occurring near the sun's poles, a fact perhaps connected with the other fact that the most active and most brilliant prominences rarely occur there.

From the photographs in which the corona is depicted actinically we pass to the drawings in which it is depicted visually. I would first call attention to two drawings made by Mr. Holiday, who formed part of the expedition, and in whose eye every one who knows him will have every confidence.

First there is a drawing made at the commencement of the totality, and then a drawing made at the end. There is a wonderful difference between the drawings; the corona is in them very much more extensive than is represented actinically on our plates.

Here is another drawing, made by Capt. Tupman, in which again we have something absolutely different from the photographs and from Mr. Holiday's sketches, inasmuch as we get an infinite number of dark lines extending down to the moon, and a greater extension than in the photographs, though in radial places the shape of the actinic corona and some of its details are shown.

Now the corona, as it appeared to me with the naked eye, was nothing but an assemblage of bright and dark lines, it lacked all the structure of the photographs, and apppeared larger; and I have asked myself whether these lines do not in some way depend on the size of the telescope, or the absence of a telescope. It seems as if observations of the corona with the naked eye, or with a telescope of small power, may give us such lines; but that when we use a telescope of large power, it will give, close to the moon, the structure to which I have referred, and abolish the exterior structure altogether, leaving a ring round the dark body of the moon such as Prof. Respighi and myself saw in our prisms, and in the 6-inch telescope, in which the light was reduced by high magnification so as to bring the corona to a definite ring some five minutes high, while Prof. Respighi, using a 4-inch telescope and less magnifying power, brought the corona down to a ring something like 7 minutes high.

And here we have an important connection between spectroscopic and telescopic work. If we employ a telescope in which the light is small or is reduced by high magnification, we bring the corona to a definite ring, and perhaps here we have the origin of the "ring-formed" coronas.

Many instances of changing rays, like those seen by Plantamour in 1860, were recorded by observers in whom I have every confidence. One observer noted that the rays revolved and disappeared over the rifts.

We have next to deal with the polariscopic observations.

Mr. Lewis, in sweeping round the corona at a distance of 6′ or 7′ from the sun's limb, using a pair of compensating quartz wedges as an analyser, which remained parallel to itself while the telescope swept round, observed the bands gradually change in intensity, then disappear, bands of a complementary character afterwards appearing, thereby indicating radial polarisation.

Dr. Thomson at Bekul saw strong traces of atmospheric, but none of radial polarisation, with a Savart. With the same class of instrument the result obtained by myself was precisely similar; while on turning in the Biquartz, at the top and bottom of the image of the corona, *i.e.*, near the sun's equator, faint traces of radial polarisation were perceptible for a short distance from the moon's limb. Captain Tupman, who observed with the polariscope after totality, announces strong radial polarisation extending to a very considerable distance from the dark moon.

Leaving the extreme outside of the corona as a question to be determined at some future time—and it can well wait—let us come to the base of the corona, and deal with the region to which I have already referred, close to the sun.

What was the general conclusion at which we arrived on this important point? Before I state it, let me tell you the instrumental conditions of the inquiry. We can use such a spectroscope as the one with which you are all familiar, and so arrange matters that the slit shall be carried by a clock, so that it may follow accurately the edge of the moon; but if the least variation in the rate of motion takes place, the observation is rendered almost valueless. But if we employ a spectroscope, in which we sum up the light—do not localise the light, but throw it together—it does not matter whether your clock goes well or not, you are certain to have a result worthy of credit. But if you employ such an instrument as Prof. Respighi employed, and abolish the slit altogether, the weight of any observations made with such conditions is very great.

Captain Maclear, who was observing with me at Bekul, has undoubtedly shown that when the light of our atmosphere is cut off by the interposition of the dark moon, we see very many more bright lines than we do when this is not the case, the lines being of unequal height.

Mr. Pringle, also at Bekul, showed that, at the end of totality, many lines flashed into one of these instruments, carried under these difficult conditions.

Captain Fyers, the Surveyor-General of Ceylon, observing with a spectroscope of the second kind, saw something like a reversal of all the lines at the beginning, but nothing of the kind at the end.

Mr. Fergusson, observing with a similar instrument, saw reversal neither at the beginning nor the end.

Mr. Moseley, whose observations are of great weight, says that at the beginning of the eclipse he did not see this reversal of lines. Whether it was visible at the end he could not tell, because at the close the slit had travelled off the edge of the moon.

Prof. Respighi, using no slit whatever, and being under the best conditions for seeing the reversal of the lines, certainly did not see it at the beginning, but he considers he saw it at the end, though about this he is doubtful.

From the foregoing general statement of the observations made on the eclipse of last year, it will be seen that knowledge has been very greatly advanced, and that most important data have been obtained to aid in the discussion of former observations. Further, many of the questions raised by the recent observations make it imperatively necessary that future eclipses should be carefully observed, as periodic changes in the corona may then possibly be found to occur. In these observations the instruments above described should be considered normal, and they should be added to as much as possible.

I had intended, if time had permitted me, to point out how much better we are prepared for the observation of an eclipse now than we were when we went to India, and how a system of photograph record should be introduced into the spectroscopic and polariscopic work; but time will not allow me to do more than suggest this interesting topic. I am anxious, however, that you should allow me one minute more to say how very grateful we feel for the assistance rendered by all we met, to which assistance so much of our success must be ascribed. I wish thus publicly to express the extreme gratitude of every one of our Expedition to the authorities in India and in Ceylon for the assistance we received from them, and our sorrow that Admiral Cockburn, a warm and well-known friend to Science, who placed his flagship at the disposal of the expedition, and the Viceroy, whose influence in our favour was felt in every region of India whither our parties went, and to whom we gave up our ship, are now, alas! beyond the expression of our thanks. We are also anxious to express our obligations to the directors and officers of the Peninsular and Oriental Company for the magnificent way in which they aided us. If they had not assisted us as they did, Science would have gained very much less than she has done from the observations of the last eclipse.

SCIENTIFIC SERIALS

THE *Journal of the Quekett Microscopical Club* for October 1872, contains but three papers, of which the first is a short one by Dr. Guy, F.R.S., on the "Hand Illuminator Microscope," which is followed by a more elaborate communication of considerable length, by Mr. M. C. Cooke, on "Old Nettle Stems and their Micro-fungi," in which twenty-seven species of fungi are enumerated and described which develop themselves on the old stems of the common nettle.—C. H. Peck, of Albany, U.S., communicates an article on the disease of plum and cherry trees in the United States known as "black knot," and his observations on the structure and growth of the *Sphæria morbosa* (Schweinitz) which accompanies, or causes, these gouty excrescences. The record of the proceedings of the club completes the contents of the present number.

Bulletin de l'Académie Royale de Belgique, No. 7. This number contains a paper, by M. P. J. Van Beneden, on the fossil whales of Antwerp, in which he describes several new types, among others, one (named Cetotherium) characterised chiefly by the articular condyle on the inferior maxillary, and forming a transition-type between the Balænoptera and the Cetodonta. Four species of Cetotherium are described. G. Dewalque gives a description, with plate, of a new fossil sponge, met with in the Eifel system; a species of the Astræospongium of Roemer, so named from the six-rayed star forms composing it. A new mode of estimating the advantage of binocular vision over monocular, as regards the brightness or clearness of objects, is proposed by H. Valerius. He employs Foucault's photometer, which consists of a long box, having a glass disc fixed in one end of it, and a pasteboard diaphragm in the direction of the axis of the box, moveable to or from the disc with screws. Lights are placed on either side of the diaphragm, which thus forms shadows on the disc, and the diaphragm is so adjusted that the shadow from each light occupies half of the disc. The lights having been so adjusted that the disc seems uniformly lighted, their relative intensities are as the squares of the distances separating them from the disc. M. Valerius uses, for his purpose, a prismatic tube, through which he observes the disc of the photometer. It contains a vertical screen which conceals one-half of the disc from one of the eyes. Suppose the disc to be receiving equal quantities of light from the two sources, the observer, on looking through the tube, finds that the half-disc seen with only one eye, appears less illuminated than the other. The equality is restored by moving one of the lights, and the distance of the motion is measured.—This paper is followed by one on formulæ in Ballistics, by J. M. De Tilly.—In the literature department, Baron Kervyn de Lettenhove gives an interesting account of certain documents which he examined at Hatfield House, bearing on the later history of Mary Queen of Scots. He discusses the celebrated casket letters, two of which are preserved at Hatfield, and are considered by him to be translations from the Scotch text. The letters are given in lithograph.—E. Varenbergh communicates an account of a journey made by three Flemish gentlemen to Nuremberg in the thirteenth century; an exact statement being made of the expenses incurred in travelling. One or two minor articles complete the number.

Poggendorff's Annalen der Physik und Chemie.—No. 7 (1872) commences with a paper of careful research, by H. Knoblauch, on the passage of heat-rays through inclined diathermanous plates. The rays, polarised by a Nicol's prism, were caused to pass horizontally to the plate, which was moveable about a vertical axis, and, passing through it, affected a thermopile. Two things determine the passage of radiant heat through inclined plates—the nature of the ray's polarisation, and the absorptivity of the substance composing the plate. These two influences are fully investigated and their effects described.—A continued account, by Hagenbach, of researches on Fluorescence is followed by a somewhat mathematical paper by Ketteler (also a continuation), on the influence of astronomical motion on optical phenomena. Dr. Stoletow discusses at some length the "Function of Magnetisation" of soft iron, and a description is given by G. Vom Rath, of the meteoric stones which fell at Ibbenbühren in 1870. W. Beetz, in a short note, contests the assertion of Zöllner, that an electric current is generated in the flowing of water, pointing out that, in the experiments made, the electric phenomena probably arose from the actual formation of a voltaic element consisting of two different metals (of tap and pipe), and the water, so that the same thing might be observed though the water was at rest. Zöllner's theory of terrestrial magnetism connects itself with the observation in question, as he supposes the flowing liquid masses in the earth's interior generate electric currents by their motion. This number contains, in addition, two contributions on the structure of hailstones, and one or two other short notes.

No. 8 contains the concluding part of Herr Hagenbach's researches on Fluorescence. His experiments, made with a great variety of substances, confirm Stokes's laws. He considers that all the rays are capable of exciting fluorescence. The maxima of the fluorescence varied from 7 (in chlorophyll) downwards. The spectrum of the fluorescent light varied also for different substances, but no necessary connection was apparent between the "intermittence" in the fluorescence of the ordinary spectrum, and that in the fluorescence spectrum. Change of solvent often displaced the maxima. He points out the similarity between phosphorescence and fluorescence, and thinks these are phenomena differing not in kind, but only in degree.—In the next paper

A. Helland adduces a large amount of evidence to show that the fjords in Norway have been formed by glacial action.—H. C. Vogel describes some careful experiments on the spectrum of aurora, which he compared with the spectra of various gases in Geissler tubes. He regards it as a modification of the air spectrum; one line of the former, at least, corresponding with the maximum brightness of the latter, while the remaining lines probably appear in the spectra of atmospheric gases under certain conditions of temperature and pressure.—A new mode of measuring rate of rotation is proposed by A. Schuller. The principle is briefly this: A disc divided into three sectors (black, red, and green), rotates on a horizontal axis; a seconds pendulum fitted with a screen, in which is a vertical slit, oscillates at the back of it, and a ray of light passes through the slit and disc to a telescope through which the observer looks. The recurrence of particular colours observed gives a means of estimating the speed of rotation.—Among the remaining papers are one on a block of lava from the recent eruption of Vesuvius, one on compounds of thallium, and one on a new form of the Noë thermopile.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, Nov. 14.—Mr. W. Spottiswoode, F.R.S., President, in the chair.—The following gentlemen were elected as officers and members of council for the ensuing session:—President, Dr. Hirst, F.R.S.; Vice-Presidents, Prof. Crofton, Mr. S. Roberts, and Mr. Spottiswoode; Treasurer, Mr. S. Roberts; Secretaries, Mr. M. Jenkins, Mr. R. Tucker; other members, Prof Cayley, Prof. W. K. Clifford, Mr. T. Cotterill, Mr. J. W. L. Glaisher, Rev R. Harley, Prof. Henrici, Mr. C. W. Merrifield, Prof. H. J. S. Smith, Mr. J. Stirling, and Mr. J. J. Walker. Messrs. Glaisher and Harley were elected in the room of Dr. Sylvester and the Hon. J. W. Strutt. The new president having taken the chair, alluded in feeling terms to the loss the mathematical world and the Society had just experienced by the death of Dr. Clebsch, of Göttingen, who had been elected a foreign member in December last. Mr. Spottiswoode then read his paper, "Remarks on some recent Generalisations of Algebra." It gave an analysis of methods used by Prof. Peirce, of Harvard, in his "Linear Associative Algebra," and by Dr. Hermann Hankel in his "Vorlesungen über die complexen Zahlen und ihre functionen," Part i. Prof. Henrici exhibited a series of models of cubic surfaces, and pointed out the several singularities, and explained how the models were constructed. Prof. Clifford next read a paper "On a theorem relating to polyhedra analogous to Mr. Cotterill's theorem on plane polygons," and exhibited several illustrative models. The plane theorem is "for every plane polygon of n vertices there is a curve of class $n-3$ touching all the diagonals; the number of diagonals is such as to exactly determine this curve and no more; and when the curve touches the line at infinity the area of the polygon is zero." The analogous theorem in space should therefore apply in the first instance to those solids whose volume can be expressed as the sum of tetrahedra, having one vertex at an arbitrary point of space, and the other three at three vertices of the figure; that is to say, it should apply to solids having triangular faces. For such solids the author finds that the analogy is very complete and exact. Defining the plane which contains three vertices and which is not a face, as a diagonal plane and a line joining two vertices, but not being an edge as a diagonal line, he proves the following theorems:—"For every polyhedron of n summits having only triangular faces (Δ faced n-acron, Cayley) there is a surface of class $n-4$, touching all the diagonal planes. This surface contains all the diagonal lines. The diagonal planes and lines are so situated, however, that the conditions of touching the planes and containing the lines are precisely sufficient to determine a surface of class $n-4$. When this surface touches the plane at infinity, the volume of the solid is zero." Prof. Clifford then proceeded to apply these propositions to polyhedra having other than triangular faces.—A paper by the Hon. J. W. Strutt was, in his absence, taken as read. Its title was "Investigation of the disturbance produced by a spherical obstacle on the waves of sound." The problem to which chief attention is given in the paper is that of a rigid spherical obstacle, which is either fixed, or (more generally) so supported that, when disturbed from the position of equilibrium, it is urged back by a force proportional to the displacement. The mathematical solution is worked out without any limitation as to the size of the sphere; but in drawing conclusions from it, attention is confined for the most part to the case when the diameter of the sphere is small compared to the length of the sound waves. Mr. Strutt then considers the problem of a fluid spherical obstacle, working it out in full for a very small sphere; and afterwards he investigates anew the same problem by a very different analysis, not restricted to the case of a sphere or an abrupt variation of mechanical properties on the one hand, but on the other less general in requiring the variation and the region over which it occurs to be small. In conclusion he indicates the solution of the problem when the source of sound is at a finite distance from the obstacle, the primary waves being accordingly spherical instead of plane.—The following abstract of M. Hermite's paper "sur l'intégration des fonctions circulaires," was furnished by Prof. Cayley. M. Hermite's paper relates to the integral

$$\int f(\sin x, \cos x)\, dx$$

where f is any rational function of $\sin x$, $\cos x$. The substitution of $e^{\iota x}=z$, where $\iota=\sqrt{-1}$, converts this into an integral of the form $\int \frac{F_1(z)}{F(z)}dz$, where $\frac{F_1 z}{F z}$ is a rational function of z, viz. $F_1 z$ and Fz are each of them a rational and integral function of z. The last mentioned integral is treated by the ordinary method of the decomposition of rational fractions; and the gist of the paper is in the transformation of the resulting expressions back from the new variable z to the original variable x, so as to obtain the required integral $\int f(\sin x, \cos x)\, dx$, in terms of the circular functions of x. It is shown that the process leads to an equation of the form $\int (\sin x, \cos x) = \Pi x + \Phi x$, where Πx is a rational and integral function of z, $\sin x$, $\cos x$: and Φx is of the form

$$\begin{aligned}\phi x = C &+ a\cot\frac{x-a}{2} + a_1\frac{d}{dx}\cot\frac{x-a}{2} +, \&c.\\ &+ b\cot\frac{x-\beta}{2} + b_1\frac{d}{dx}\cot\frac{x-\beta}{2} +, \&c.\\ &+ \&c.\end{aligned}$$

each series, and also the number of the different series, being finite: so that the integration is made to depend upon the integrals

$$\int \Pi\, x dx \text{ and } \int \cot\frac{x-a}{2}\, dx = 2\log\sin\frac{x-a}{2}$$

The paper contains processes for the complete determination of the coefficients, C, a, a_1, &c. and other interesting matter.

Meteorological Society, Nov. 20.—Dr. Tripe, president, in the chair.—On the storms experienced by the Submarine Cable Expedition in the Persian Gulf on November 1 and 2, 1869, by Mr. Latimer Clark. The first storm occurred at 9 o'clock at night, when the vessels of the expedition were about 130 miles from Bushire, and burst upon them without any preliminary warning, lowering the temperature by nearly 30° in a few minutes. It was accompanied by heavy rain and much lightning and thunder, and progressed from N.W. to S.E. After the tempest had lasted for two hours the wind changed to a gale from S.E., and subsequently fell calm as before The next day the cable was spliced up, and paying out had scarcely re-commenced, with a strong south-east wind, when notice was received that another violent storm from the north-west had passed Bushire, and was on its way down the Gulf. At 3 o'clock black clouds were seen rising, and at 3.52 the storm burst forth with the same suddenness and fury that characterised the previous one. Being daylight many phenomena were observed which were missed the night before. As the clouds approached they gathered into a peculiar form, resembling the cap of a large mushroom, extending across the heavens from one horizon to the other. The lower edge had a rounded and wrinkled margin, but was very sharply defined; the surface was composed of innumerable similar strata, as if melted pitch had been poured out and allowed to solidify in numerous cakes, each rather smaller than the one below.* Suddenly there came a profound calm, and a few hundred yards ahead the squall was seen approaching. The sea was elsewhere covered with full-sized waves, but under the influence of the hurricane it became one dead-level of creamy foam, the top of every wave being swept off into spray as soon as it arose. When the squall struck the vessels the thermometer fell at once from 81° to 53°; torrents of rain swept the decks, accompanied with continuous thunder and lightning. After two hours the wind changed into a gale from the south-east, followed by a calm. It was noticed that the barometer was unaffected till the last moment, but as soon as the storm arrived it rose two-tenths of an inch, and fell again as it passed over. The electrical instruments, although of the most sensitive character, were not at all affected during the storm. The other papers read were "On the Meteorology of Southland, New Zealand, in 1871," by Mr. C. R. Martin, and "On a Self-registering Tide-gauge and Electrical Barograph," by Mr. H. C. Russell, B.A., Government Astronomer, Sydney.

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* This is the form of cloud mentioned by M. Poey in NATURE, Vol. iv. No. 103.

PARIS

Academy of Sciences, Nov. 18.—M. Faye, president, in the chair.—The meeting commenced with another instalment of the ferment controversy, M. Pasteur rising and objecting to M. Fremy's remarks as reported in the *Comptes Rendus* of the last meeting. M. Bouillaud followed, expressing his regrets that M. Pasteur's proposition with regard to the experiments had not been acceded to. M. A. Trécul then rose, and regretted that certain words which had appeared in the same number had not been uttered at the meeting. He then read a note criticising M. Pasteur's remarks at that meeting. The discussion then dropped, and M. Tresca read a note on the best form for the international standard meters. He proposes a section like the letters H or X.—M. Bouillaud then read a paper on the theory of the production of animal heat.—M. F. Perrier read a paper on the prolongation of the French meridian into the Sahara by means of the trigonometrical junction of Algiers with Spain.—The next paper was by M. Jeannel on the natural production of nitrates and nitrites. Among other conclusions the author arrives at this, that "calcareous humus" in drying determines the combination of the elements of the air.—M. Max Marie presented the concluding paper of his series on the elementary theory of integrals of any order and their periods, after which followed a paper on a new method of analysis founded on the use of imaginary co-ordinates, by M. F. Lucas.—M. C. Dareste presented his fifth paper on the osteological types of osseous fishes.—"Studies on the ventilation of transports" was a paper by M. E. Bertin, giving the results of some experiments on ventilation made on board the *Calvados* and *Garonne*, transports. The apparatus used, worked by the waste heat of the furnaces, evacuated 35,000 cubic metres of air per hour from the lower decks.—Notes on the *Phylloxera* were received from M. Saint-Pierre and M. Loarer. The former has found the insects on the wild vines of Vaucluse known as *lambrusques*, and hence considers that the general opinion that this disease is the result of cultivation is erroneous. Both letters were sent to the *Phylloxera* Commission, and notes from M. F. Barilla on a remedy for cholera, and M. G. Fabretti on the transmission of infectious miasmata were sent to that appointed to administer the Bréant legacy.—A note from M. Curral on the realisation of perpetual motion in the planetary system was submitted to the examination of M. Phillips, while a note from M. Andru on the quadrature of the circle was, in accordance with a very old rule of the Academy, considered as not received.—M. Serret then presented a note on the planetoid 116 Sirona, by M. F. Tisserand.—M. J. Bourget's Memoir on the Mathematical Theory of Kundt's acoustic experiments followed, after which came a note on "Magnetic Energy" by M. A. Cazin.—M. E. Becquerel next presented a note on the multiplicity of images, and the theory of accommodation, a paper on optical physiology, by M. F. P. Le Roux.—M. Sainte-Claire Deville then communicated an account of M. Cailletet's researches on liquid carbonic anhydride and M. F. Pisani's description and analyses of a new silver amalgam from Konsberg in Norway.—M. Becquerel presented M. Aug Gueront's researches on the action of sulphurous anhydride on recently precipitated insoluble sulphides. The author finds that a hyposulphite is the result of the reaction which takes place in three successive stages, these are the formation of a sulphite and hydrosulphuric acid, the decomposition of the latter, and of the sulphurous anhydride into sulphur and water, and the combination of this sulphur, whilst in the nascent state, with the sulphite formed at first.—A note on the geographical distribution of the *Percina* by M. Léon Vaillant came next; and then M. A. Gaudry's note on a tooth of *Elephas primigenius* from Alaska. The tooth contained as much as 23·97 per cent. of organic matter.—Next came M. A. Laboulbène's paper on the elevation of central temperature in cases of acute pleurisy, on the abstraction of the liquid from the pleura, the temperature rose from 0°·2 to 0°·3 C. after the operation.—M. Béchamp followed with observations on M. Pasteur's paper, in which he stated that the wine ferment came from the grape skin.

BOOKS RECEIVED.

ENGLISH.—How I found Livingstone in Central Africa: H. M. Stanley (Sampson Low and Co.)—A Report on the Expedition to Western Yunan, *viâ* Bhamô: Dr. Anderson, Calcutta.—Mineral Phosphates and Pure Fertilisers: C. Morfit (Trübner)—The Physiology of Man; Nervous System: A. Flint (Appleton and Co).—Elements of Zoology: Andrew Wilson (A and C. Black).—Small Pox and Vaccination: Dr. C. Both (Trübner).

FOREIGN.—Beiträge zur Biologie der Pflanzen: Dr. F. Cohn, Heft II.

DIARY

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 8.30.—On the Colouring Matters derived from Aromatic Azodiamines. 2. Safranine: Dr. Hofmann, F.R.S., and Dr. Geyger.—Synthesis of Aromatic Monamines, by intra-molecular atomic interchange: Dr. Hofmann, F.R.S.—Investigation of the Attraction of a Galvanic Coil on a small Magnetic Mass: J. Stuart.

SOCIETY OF ANTIQUARIES, at 8.30—On Certain Prevailing Errors respecting French Chambered Barrows: Rev. W. C. Lukis, M A.

LINNEAN SOCIETY, at 8.—On the Skeleton of the *Apteryx*: Thomas Allis.—On New and Rare British Spiders: Rev. O. P. Cambridge, M.A.

CHEMICAL SOCIETY, at 8.—On the Reducing Power of Phosphorous and Hypophosphorous Acids and their Salts: Prof. C. Rammelsberg.—On Hypophosphites: Prof. C. Rammelsberg.—On New Analyses of some Mineral Arseniates and Phosphates: Prof. A. H. Church.

FRIDAY, DECEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—On Coal Seams in the Permian at Ifton, Shropshire, with Remarks on the Supposed Glacial Climate of the Permian Period: D. C. Davies.—Note on a Well Section at Finchley: Caleb Evans.

SUNDAY, DECEMBER 8.

SUNDAY LECTURE SOCIETY, at 4—On Arctic Experience; with a description of the Esquimaux; John Rae, M.D.

MONDAY, DECEMBER 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, DECEMBER 10.

LONDON INSTITUTION, at 4.—On Elementary Physiology: Prof. Rutherford.

PHOTOGRAPHIC SOCIETY OF LONDON, at 8.—Landscape Photography: F. C. Earl—A New Actinometer: J. R. Johnson.

WEDNESDAY, DECEMBER 11.

SOCIETY OF ARTS, at 8.—On Galvanic Batteries: Rev. H. Highton.

THURSDAY, DECEMBER 12.

ROYAL SOCIETY, at 8.30.

SOCIETY OF ANTIQUARIES, at 8.30.

LONDON MATHEMATICAL SOCIETY, at 8—On Geodesic Lines, especially those of a Quadric Surface; and on the Mechanical Description of certain Quartic Curves by a modified Oval Chuck: Prof. Cayley.—Note on the breaking up of the Inharmonic-ratio Sextic: J. J. Walker.

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ERRATA.—No. 157, p. 540, 2nd col, l. 15: For "2328·3 = 2,250,821,000," read "2328·3 × 2,250,821,000;" p 541, 1st col, l 14 from bottom: for "absolute certainty" read "supposed absolute certainty." No. 160, p. 47, 1st col., l. 14: for "water-fall" read "water falling."

THURSDAY, DECEMBER 12, 1872

SCIENTIFIC RESEARCH AND UNIVERSITY ENDOWMENTS

NOTWITHSTANDING the great development of scientific education, and the firm and prominent position which Science holds in public estimation, it must be admitted that a profound dissatisfaction and anxiety are the prevailing feelings with which the conditions and prospects of English science are regarded by the cultivators of knowledge. To the outside observer these sentiments appear simply captious and unreasonable. When so much has been done, why on earth should we complain? The truth, however, unhappily is, that in the midst of our apparent abundance we have still a great deficiency; and those fruits and results of Science, in the way of scientific research and discovery, which afford the true measure of our scientific condition, have by no means proportionably increased. Indeed it may be doubted whether the annual harvest of scientific truth is even as abundant as twenty or thirty years since, when Science had hardly penetrated even the outer crust of English society. The character of our scientific periodicals is essentially altered. The Journal of the Chemical Society, for example, of which the original and proper function was to print the investigations of English chemists, now appears to exist simply to inform us of what is accomplished elsewhere. The volume for the year 1871 is a stout octavo of 1,224 pages; of these, however, not more than 154 are occupied with original communications read before the Society, while the rest of the volume is filled with innumerable abstracts of the investigations of the chemists of Germany and France. Ten years ago the same journal contained on the average at least 400 pages of original matter.

Now, the perfection of science, in all the various aspects in which it appears as an instrument of human progress, is manifested only in scientific inquiry; and to the scientific mind no technical skill, no abundance of information, can be a substitute for this, or compensate for its absence.

This view of the condition of Science is not invalidated by the circumstance that a certain number of distinguished Englishmen are to be found whose scientific work is of the highest order.

In this country there are now, as has been the case in each generation for the last two hundred years, a limited number of individuals of powerful intellect and elevated aspirations, who have made scientific research the main purpose and object of their lives. Of such we have happily sufficient living examples to preserve among us the true type of the scientific investigator, and to dispel the apprehension of intellectual degeneracy. The labours, however, of modern Science are on far too extensive a scale to be carried on simply by the efforts of eminent individuals. Science requires the services of a class devoted to the extension of knowledge, precisely as other classes of society are devoted to commerce, to politics, or to agriculture. Such a class does not exist among us, and its absence is the greatest defect in our social system.

Undoubtedly there are many causes which interfere with the growth of such a class. The unremunerative character of scientific work, the want of intelligent appreciation on the part of the public, of even the value and importance of such work by which the student is deprived of that most powerful stimulus to exertion, the sympathy and support of others, deter many from the career of Science. Moreover, the very spread of scientific knowledge and education is, in its results, by no means in all respects favourable to the pursuit of pure Science. A demand is created for the services of scientific men in a technical direction which it is very difficult to meet, and which induces the student of Science to turn his attention to the practical and remunerative rather than to the theoretical aspect of his vocation. Many a man, too, of genius for research is compelled by the sad necessities of life to labour at the oar for the service of the community, is drafted into the ranks of popular lecturers to amuse the public with ready talk and brilliant experiments, or spends a life which he would willingly devote to scientific investigation as an officer of health, or an analytical and manufacturing chemist.

Such impediments, however, to the indulgence of men's higher tastes and desires, have their root in the very organisation and necessities of modern society, and are not peculiar to English life. But Science has in this country one special difficulty to contend with—the utter apathy in regard to the advancement of knowledge which has so long prevailed at the English Universities, which, without any doubt, is the main cause of our disasters. In Germany the universities are the very centres of intellectual progress; and we might reasonably have hoped that here also amid the distractions of modern life these great institutions would have afforded at least one refuge for science and learning, and have supplied the few who might possess any exceptional capacity for these pursuits with the means of existence and the means of work. Such, indeed, was undoubtedly the main object to which these noble institutions were destined by their founders, who equipped them with all the appliances necessary for the cultivation of the knowledge of their day. But, unfortunately, they fell into wrong hands, and the class to whose protection and care these great interests were confided betrayed in every way the trust committed to them; until at length abuses reached such a point that, after a prolonged agitation, university reformers succeeded in obtaining the interference of the Legislature in the form of the Executive Commission of 1854. The unsatisfactory way in which this commission proceeded to remedy the evils complained of is even now not generally understood.

When we consider the profound importance of learning and scientific discovery, not alone to the material and physical, but also to the intellectual and moral progress of the nation, we might well have anticipated that in any reform of the universities the first object of our statesmen and legislators would have been to provide for these great interests, and to restore the endowments of the university in this respect to their ancient uses. But the commission did nothing of the kind; its efforts were mainly directed to the suppression of pecuniary jobbery. But this having been effected, the further changes which they introduced proceeded upon the lowest possible estimate of the functions of an University, which they appear to have regarded not at all as a national instrument for the furtherance of knowledge, but simply as a superior kind of Grammar School. Of the University, as thus understood, pecuniary prizes were to be the motive power, and competitive examination the regulating principle. The resources of the colleges were dealt with from this point of view. Numerous scholarships were founded for the support of students, on a scale so extensive, that, as has been computed, one-third of the students of Oxford are thus subsidised during their University career. The remainder and greater part of the endowments was nearly all devoted to fellowships, varying in value from 200*l.* to 300*l.* a year; on these two objects it is estimated that at least 120,000*l.* is annually expended by the colleges of Oxford.

The fellowship which they thus created is indeed a unique and singular institution. It is a life-estate conferred by a corporate body, without exacting in return any services whatever from its possessor, either to the college or to the community at large; and the chief result of the labours of the Executive Commission, whose business it was to reform the University, was the establishment of this gigantic system of sinecure pensions, conferred upon young men in the prime and vigour of life, as the reward of having passed a successful examination. When the ordinances framed by the Commissioners come fully into operation, there will be, in Oxford alone, about 300 sinecure fellowships.

In the arrangements of the Commissioners the most contemptuous disregard was manifested for the interests of science and learning. A few professorships of ancient date founded by men of a very different stamp, which the colleges had suppressed, were revived, but no real or adequate provision was made even for the maintenance of lecturers and professors necessary to carry on the education of the place, and out of these vast funds, not a sixpence was devoted to the advancement of knowledge or the promotion of scientific or literary research, or to the support of museums and laboratories.

These arrangements were not based upon any very high estimate of human motives and desires, and it would have been surprising indeed if an ideal University, devoted to the interests of learning, knowledge, and truth, should have sprung from such ashes. As a matter of fact, complaints are heard on all sides of the futility of this system, and the necessity of a redistribution of the college endowments is widely felt. In this movement the Government have taken the initiative by the appointment of a Royal Commission to inquire into the revenues of the Universities and Colleges of Oxford and Cambridge. These revenues have never as yet been fully disclosed, but we may anticipate that a good deal of surprise and even indignation will be felt when the amplitude of these resources is contrasted with the inadequate results attained by them. Another contingency will then arise, to be deprecated by every lover of knowledge, the possible alienation and dissipation of the noble inheritance of science and learning which has been so inappropriately employed.

It was in connection with these questions and with the view of considering the best application, in the interests of mature study and scientific research, of the endowments of the Universities and Colleges of Oxford and Cambridge that the public meeting was held at the Freemasons' Tavern on November 16, of which the report appeared in this journal on November 28. The spirit and purpose of those present at this meeting will be best understood from the resolutions passed by it. These resolutions were :—

1. That to have a class of men whose lives are devoted to research is a national object.

2. That it is desirable, in the interest of national progress and education, that professorships and special institutions shall be founded in the Universities for the promotion of scientific research.

3. That the present mode of awarding fellowships as prizes has been found unsuccessful as a means of promoting mature study and original research, and that it is desirable that it should be discontinued.

4. That a sufficient and properly organised body of resident teachers of various grades should be provided from the Fellowship Fund.

The Society for the Organisation of Academical Study, founded at this meeting, is constituted by no means in the exclusive interests of the natural sciences, but for the sake of the totality of knowledge. The apprehensions which are felt in regard to the condition of research in the physical sciences, are similarly and equally felt in other departments of knowledge, and the objects of this Society are such as to secure the good-will and adhesion of every genuine student. Much consideration will be necessary to devise really practical arrangements, by which such ideas may be carried out. On this point the evidence of those distinguished persons who have been examined before the Science Commission will be of the greatest value; but it is to be hoped that all those who are familiar with the requirements of the several departments of Science will turn their serious attention to the subject, and give to the Society the benefit of their co-operation and advice, with the view of hereafter laying before the Government an adequate and practical scheme for the re-constitution of the Colleges and Universities, not simply as educational bodies, but as national foundations for the preservation and extension of knowledge. B. C. BRODIE

THE METEOROLOGY OF THE FUTURE

IT would be a curious inquiry which we commend to those learned in statistics, to determine how many millions of observations have been made in the British Isles on dry and wet bulb thermometers, on barometers, and on other meteorological instruments. It would be a still more curious inquiry, seeing that the infinite industry displayed in these observations shows that the importance of the study of Meteorology is universally conceded, to determine why it is that meteorologists, state-endowed and otherwise, have, as a rule, been content to grope their way in the dark, and not only not seek to find, but persistently refuse the clue, which, if followed, would bring them into the light of day. When some one some centuries hence—thank heavens, we have always that to look to in all branches of research—comes to consider the work done by meteorologists during the present century, he will, unless he be some patient German Dryasdust determined to examine all minutes of Boards of Visitors, all Kew Committee Records, and the like, give up the task in the most utter despair, and on the whole perhaps this is the best thing that could happen.

Surely in Meteorology, as in Astronomy, the thing to hunt down is a cycle, and if that is not to be found in the temperate zone, then go to the frigid zones or the torrid zones to look for it, and if found, then above all things, and in whatever manner, lay hold of, study it, record it, and see what it means. If there is no cycle, then despair for a time if you will, but yet plant firmly your science on a physical basis, as Dr. Balfour Stewart long ago suggested, before, to the infinite detriment of English science, he left the Meteorological Observatory at Kew; and having got such a basis as this, wait for results. In the absence of these methods, statements of what is happening to a blackened bulb in vacuo, or its companion exposed to the sky, is, for research purposes, work of the tenth order of importance.

I said the thing to hunt down is a cycle. Now it may be asked,—Is there anywhere on earth a weather cycle? but anyone who asks this question will at once answer it himself—the question would certainly suggest the trade-winds and monsoons, which are short-period cycles. But is there anything more than this?

When I was preparing to go to India last year to observe the eclipse, Mr. Ferguson, the able editor of the *Ceylon Observer*, who happened to be in London, was good enough (he was good enough to us all afterwards, and the Eclipse Expedition of 1871 have much to thank him for) to give me much valuable local information about the time of the year at which the monsoons broke up in the island. Nor was this all; he added that everybody in Ceylon recognised a cycle of about thirteen years or so in the intensity of the monsoon—that the rainfall and cloudy weather were more intense every thirteen years or so. This of course set one interested in solar matters thinking, and I said to him, "But are you sure the cycle recurs every thirteen years; are you sure it is not every eleven years?" adding as a reason that the sun-spot period was one of eleven years or thereabouts, and that in the regular weather of the tropics, if anywhere, this should come out.

This conversation Mr. Ferguson thought fit to reproduce in the *Ceylon Observer*, and I have now lying before me a cutting from a number of that paper I saw in India, (unfortunately it is cut too much, for both date and writer's name are gone) from which I make the following extract. "The period is not *thirteen* years but eleven (as Lockyer states it). In the tropics, or at least, here in Ceylon, where we enjoy the regular changes of the two monsoons, the basic period runs five or six years dry, and five or six years wet. These make *eleven*, and they form the medium cycle of *three*—the grand cycle of thirty or thirty-three years—being three periods of the eleven cycles. But I must premise here that though I adopt these figures as noting a general run of cycle, it is by no means to be expected that, always, these changes shall run with mathematical correctness in given grooves, for there may be thirteen at one time, and next eleven, giving a grand cycle of thirty or thirty-three years."

It will be seen, then, that those who are not professed meteorologists recognise not only the eleven-year period in the Ceylon rainfall, but possibly also a higher one still—that of thirty-three years. In the press of work that has fallen upon me since my return to England, after my three months' absence, I have been prevented from taking the opinion of my meteorological friends upon this most important matter; but now there comes evidence on the question from an authority whose facts and opinions at once settle the matter.

Mr. Meldrum, of the Mauritius, to whom belongs the honour of having established that the number of cyclones in the Indian Ocean and the West Indies varies with the sun-spot area, has lately attacked the rainfall of the Mauritius, Queensland, and Adelaide from the sun-spot period point of view, with results which are simply startling, although Mr. Meldrum very properly puts them forward to stimulate further inquiry, and not as final.

Mr. Meldrum's step from cyclones to rainfall is a very obvious one, because it is well known that cyclones are generally accompanied with torrential rains. The years, therefore, in which cyclones are most frequent should be more rainy than the years in which they are less frequent. But Mr. Meldrum remarks, in his paper communicated to the Meteorological Society of the Mauritius, "to make the rainfall a fair test of the existence of a periodicity of cyclones in the Indian Ocean it would be necessary to know the annual rainfall over the same area for the same length of time. If such rainfall had no periodicity, we should have reason to doubt a cyclone-periodicity; but if there was a similar rain-periodicity, it would, so far, be a confirmation of a cyclone-periodicity."

Accordingly, as it is impossible to determine the rainfall over the ocean, the law of the cyclones of which has been approximately determined, there remains but one course open, to observe the rainfall on the nearest points of land. This is as follows for the above-named stations:—

BRISBANE.		ADELAIDE.		PORT LOUIS.	
Years.	Rainfall. Inches.	Years.	Rainfall. Inches.	Years.	Rainfall Inches.
		1839	19·840		
		1840	24·107		
		1841	17 956		
		1842	20·318		
		1843	17·192		
		1844	16·878		
		1845	18·830		
		1846	26·885		
		1847	27·613		
		1848	19·735		
		1849	25·444		
		1850	19·274		
		1851	30·633		
		1852	27·340		
		1853	26·995	1853	39·829
		1854	15·346	1854	39·435
		1855	23·145	1855	42·665
		1856	24·921	1856	46·230
		1857	21·156	1857	43·445
		1858	21·522	1858	35·506
		1859	14·842	1859	56·875
1860	54·63	1860	19·670	1860	45·165
1861	69·44			1861	68 733
1862	28·27			1862	28·397
1863	68·82			1863	33·420
1864	47·00			1864	24·147
1865	24·11			1865	44·730
1866	37·24			1866	20·571
1867	61·04			1867	35·970
1868	35·98			1868	64·180
1869	54·36			1869	54·575
1870	79·06			1870	45·575
1871	45·45			1871	41·610

Now, we know, to start with, that the years of minimum and maximum sun-spot frequency were as follows :—

Min. epochs . . . 1833, 1844, 1856, 1867
Max. „ . . . 1837, 1848, 1860, 1871 (?)

and Mr. Meldrum has shown that these years were also those of minimum and maximum cyclone frequency. Let us begin by examining the Port Louis Observations, embracing nineteen years (1853-1871).

Taking the rainfall in each minimum and maximum epochal year, and in one year on each side of it, Mr. Meldrum gets—

	Years.	Rainfall.	Total Rainfall.
Min.	1855 . . .	42·665	133·340
	1856 . . .	46·230	
	1857 . . .	43·445	
Max.	1859 . . .	56·875	170·774
	1860 . . .	45·166	
	1861 . . .	68·733	
Min.	1866 . . .	20·571	120·721
	1867 . . .	35·970	
	1868 . . .	64·180	

"These figures show a marked excess of rainfall for the three years comprising the maximum sun-spot year (1860), which was also the year of maximum cyclone frequency.

"If in place of one year, we take two years on each side of the epochs, we shall get—

	Years.	Rainfall.	Total Rainfall.
Min.	1854 . . .	39.435	207·281
	1855 . . .	42 665	
	1856 . . .	46·230	
	1857 . . .	43·445	
	1858 . . .	35·506	
Max.	1858 . . .	35·506	234 677
	1859 . . .	56·875	
	1860 . . .	45·166	
	1861 . . .	68·733	
	1862 . . .	28·397	
Min.	1865 . . .	44·730	220·026
	1866 . . .	20·571	
	1867 . . .	33·970	
	1868 . . .	64·180	
	1869 . . .	54·575	

Here, again, a similar result is shown. It is not so well-marked as the former one, partly owing, Mr. Meldrum suggests, to the rain-gauge having been removed in 1866 to a temporary Observatory, where the rainfall was probably somewhat greater.

"So far, then, as the Port Louis observations enable us to judge, it may be said that during the last twenty years there has been a rainfall-periodicity corresponding with the cyclone-periodicity in the Indian Ocean south of the Equator.

"This may be considered as confirmatory of the correctness of the cyclone period ; for if the rainfall *at one station* shows a corresponding periodicity, much more should *a mean of the rainfall at many stations* within the whole cyclonic area do so."

Mr. Meldrum next passes on to the Australian observations, remarking that, although Adelaide and Brisbane are a long way outside the area for which the cyclone period was determined, there also the rainfall tables seem to point to a similar periodicity.

The *Adelaide* twenty-two years' observations give :—

	Years.	Rainfall.	Total Rainfall.
Min.	1843 . . .	17·192	52·900
	1844 . . .	16·878	
	1845 . . .	18·830	
Max.	1847 . . .	27·613	72·792
	1848 . . .	19·735	
	1849 . . .	25·444	
Min.	1855 . . .	23·145	69·222
	1856 . . .	24·921	
	1857 . . .	21·156	

By taking five-year periods we get :—

Minimum = 100·076 inches.
Maximum = 118·951 „
Minimum = 106·090 „

We next come to twelve years' observations at Brisbane, for which science is indebted to Mr. Edmund McDonnell. Comparing them with the Mauritius observations for the same period, we cannot but be struck with a resemblance, which comes out still more forcibly when we take three-year periods, thus :—

Years.	Port Louis.			Brisbane.
1860	45·166	142·296	54·63	152·34
1861	68·733		69·44	
1862	28·397		28·27	
1863	33·420	102·297	68·82	139·93
1864	24·147		47·00	
1865	44·730		24·11	
1866	20·571	120·721	37·24	134·26
1867	35·970		61·04	
1868	64·180		35·98	
1869	54·575	141·760	54·36	178·87
1870	45·575		79·06	
1871	41·610		45·45	

At both stations the epoch of minimum rainfall is coincident, or nearly so, with the epoch of minimum amount of cyclones, which is itself coincident with the minimum amount of sun-spots ; and that at, or near, the maximum of sun-spots and cyclones, we have also a maximum amount of rainfall.

Mr. Meldrum's important paper concludes as follows :—

"From what has been said it will, I think, be admitted that at least a case of *supposed* periodicity of rainfall has been made out, and that it is highly desirable that the matter should be further investigated. This can be done chiefly by long-continued observation under the same conditions as to locality, size of gauge, &c., and perhaps to some extent by ascertaining, if not the actual rainfall, at least the years remarkable for the comparative absence or abundance of rain in former times.

"It should be remarked that some localities are probably much more favourable than others for showing the operation of a general law of this kind ; for there may be local causes affecting the rainfall so powerfully as to completely mask the effect of a weaker but more general cause ; and therefore it would be no proof of the non-existence of a connection between rainfall and sun-spots to show that the observations taken at such and such places were not in conformity with the supposed periodicity.

"We should be inclined to think that the best mode of testing the matter would be to obtain records of observations carefully made for a long period in some of the islands of the Indian and Pacific Oceans, for example, far removed from the disturbing influence of Continents, and then to take a mean of all the observations.

"The Adelaide and Brisbane observations would seem to indicate a rainfall-periodicity altogether independent of a cyclone-periodicity, both being apparently the natural consequences of one and the same law. But it would be rash to say more at present, and I should wish it to be understood that the object of this paper is simply to stimulate further inquiry."

Since Mr. Meldrum's results have reached me, I have tested the Cape and Madras rainfall, to see if the same result is to be got from them, and with the following results:—

	Cape.	Inches.	
Max.	1847	22·4	68·6
	1848	23·2	
	1849	23·0	
Min.	1854	20·0	63·9
	1855	24·5	
	1856	19·4	
Max.	1859	36·7	91·2
	1860	29·1	
	1861	25·4	
Min.	1866	19·2	62·0
	1867	22·9	
	1868	19·9	
Max.	1869	32·3	62·3
	1870	28·0	

(For two years only)

From the Madras observations at my disposal only one maximum and one minimum can be given:—

	Cape.	Inches.	
Min.	1843	41·0	125
	1844	45·0	
	1845	39·0	
Max.	1847	81·0	175
	1848	40·0	
	1849	54·0	

Surely here is evidence enough, evidence which should no longer allow us to deceive ourselves as to the present state of meteorology. A most important cycle has been discovered, analogous in most respects to the Saros discovered by the astronomers of old. Indeed, in more respects than one, may the eleven-yearly period be called the Saros of meteorology, and as the astronomers of old were profoundly ignorant of the true cause of the Saros period, so the meteorologists of the present day are profoundly ignorant of the true nature of the connection between the sun and the earth.

What, therefore, is necessary in order to discover the true nature of this nexus? Two things are necessary, and they are these. In the first place, we must obtain an accurate knowledge of the currents of the sun, and secondly, we must obtain an accurate knowledge of the currents of the earth. The former of these demands the united efforts of photography and spectrum analysis, and the second of these demands the pursuit of meteorology as a physical science, and not as a mere collection of weather statistics. When these demands are met—and in spite of the Mrs. Partingtons who are endeavouring to prevent this, they will soon be met—we shall have a Science of Meteorology placed on a firm basis—the Meteorology of the Future.

J. NORMAN LOCKYER

HARTING'S HANDBOOK OF BRITISH BIRDS

A Handbook of British Birds. Showing the distribution of the resident and migratory species in the British Islands, with an Index to the records of the rarer visitants. By J. E. Harting, F.L.S., F.Z.S. 8vo. Pp. 198. (London: Van Voorst.)

MR. HARTING'S "Handbook of British Birds" will be of much use as an easy work of reference to the many students of the feathered tribes of these islands, although it can only be employed as a supplement to one of the standard authorities on the same subject. It consists of two parts—first, a list of the British birds, properly so called, being residents, periodical migrants, and annual visitants; and, secondly, a list of rare and accidental visitants. In the former part a short account of the distribution of the species within the British Islands is given; in the latter a complete list of *all* the recorded occurrences of the species within the same limits. In the latter case the list seems to have been very carefully compiled, and will be of great use to the collector, who, without it, would have to refer to a dozen different journals and periodicals, in order to ascertain how often any "rare visitant" had been previously noticed.

Mr. Harting's estimate of the total number of "British birds," ordinarily so-called, is 395, being 43 more than that of the third edition of Yarrell's History. "Of these, in round numbers, 130 are Residents, 100 Periodical Migrants, and 30 Annual Visitants, the remainder being Rare and Accidental Visitants." The last-named category, it will be observed, forms a large proportion of the total number of species usually included in the British list, being at the present time 135 out of 395, or rather more than one-third of the whole. And this is a proportion which is certain to be considerably increased as time progresses, not a year passing without the arrival of one or more stragglers from distant lands, the occurrence of which has not been previously recorded.

The composition of the "Accidental" list is a matter of considerable interest. Mr. Harting classes 14 as Asiatic, 11 as African, and no less than 43 as American. "It is extremely difficult," our author remarks, "to believe that the non-aquatic species of the last category have actually journeyed across the Atlantic, and performed a journey of 1,700 miles on the shortest route, *viâ* Newfoundland; but that most of them have actually done so seems proved by the fact that they have never been met with in Greenland, Iceland, and the Faroe Isles (the only countries through which they would otherwise have passed by a change of route); and that many which have thus found their way to England or Ireland (as, for example, *Agelæus phœniceus*, *Cuculus americanus*, *Ceryle Alcyon*, *Ægialitis vociferus*, *Totanus solitarius*, *Tringa bonapartii*, *Botaurus lentiginosus*, and others) have never been met with on any part of the European continent. As might be expected, at least half the American species found in this country belong to the orders Grallatores and Natatores, while of the fourteen species of Insessorial birds, none of them, with the exception of *Agelæus phœniceus*, has occurred half-a-dozen times. This plainly shows that their appearance on this side of the Atlantic is the merest accident, and not the result of any continued and successful attempt at migration. In some instances, at least, it is not unreasonable to suppose that these small birds must have availed themselves, to a great extent, of the rigging of passing vessels, or have been brought to this country in cages, from which they have been allowed, accidentally or designedly, to escape."

As regards the nomenclature and arrangement of the birds contained in his lists, Mr. Harting has not, we think, been quite so successful as in his accounts of their range and of their occurrences in the British Islands. The American Cuckoos are certainly not referable to typical *Cuculus*, and ought to stand as *Coccyzi*. *Erithacus* (not *Erythaca*) is the correct spelling for the generic name of the Red-breast, as any Latin dictionary will show. The Hirundinidæ are typical Passeres, and should not be placed between the Bee-eaters and Swifts, as Mr. Harting proposes (p. 35). The Ibises should not be referred to the family "Tantalidæ." *Tantalus* is nothing more or less than a form of Stork, and should be placed under the Ciconiidæ; whilst the Spoonbills (arranged by Mr. Harting as an independent family, really appertain to the group of Ibises (Ibididæ). The interposition of the Cranes between the Storks and Herons is most unnatural. There can be no question that the nearest relatives of the *Grues* are the Bustards and Rails. What can be the object of inventing such a family as the Petrocinclidæ (p. 99)? The Spine-tailed Swift is by no means a *Cypselus*, as Mr. Harting calls it (p.. 127), but belongs to a different sub-division of the Cypselidæ, distinguished by the structure of its feet. Lastly, when such excellent genera as *Coccyzus* and *Chætura* are rejected, it is going a little too far to follow Coues and Bonaparte in adopting such a mere section of *Procellaria* as *Æstrelata*.

It would not be difficult to extend our criticisms in this direction, but it is only fair to say that such minor defects will not seriously interfere with the great usefulness of Mr. Harting's "Handbook of British Birds."

OUR BOOK SHELF

The Clematis as a Garden Flower. By Thomas Moore, F.L.S., and George Jackman, F.R.H.S. (London: Murray.)

A NOTICE of a book of this kind may at first sight seem out of place in a scientific periodical. Those stray threads, however, of biological investigation which have at various times attracted curiosity rather than study, and have, at any rate, been for the first time methodised in Darwin's "Animals and Plants under Domestication," will depend upon works of this kind for their further development. It is hardly generally understood that the production of what are called in popular language, "Florists' flowers" rests on two perfectly different principles and methods of procedure. The one is obvious enough; it may be called an accelerated natural selection, consisting as it does of merely growing on a very large scale the plant which it is desired to improve, and then selecting repeatedly from the sports which are sure to occur those which conform most nearly to some preconceived standard. But the other and far less thoroughly understood method consists in destroying the fixity of ancestral type by persistent and involved hybridising. At first the hybrids are, as might be expected, intermediate between their parents; after a time, however, the seedlings from crosses exhibit variations of habit and characters which could not possibly be expected, and which, consequently, make the business of raising new horticultural varieties almost as speculative as a lottery. Florists' flowers are, consequently, the expression of the action of laws of which we at present know next to nothing, but the investigation of which is of the highest interest. The only possible way of pursuing it is obviously the careful comparison of a hybrid offspring with its various progenitors, somewhere amongst which the latent characters must lurk concealed which reveal themselves often so unexpectedly. A book of this kind is naturally, therefore, turned to in the expectation of its supplying facts of the kind required. A difficulty, however, diminishes, as in other cases, its value in this respect. Horticulturists, as a body, are far from unsympathetic towards scientific inquiry; but business operations cannot always be carried on in a scientific spirit. When crosses are made for the purpose of producing new forms, it is generally done on a large scale, and quite promiscuously, merely avoiding what practical tact points out as undesirable strains. No record is kept, and the seeds are often sown in a single batch; consequently, if a striking variety makes its appearance, it is often all but impossible, as for trade purposes it is not necessary, to assign to it its proper ancestry. Take, for example, a garden *Clematis*, named after its producer, *C. Jackmanni* (botanically, by the way, a hardly legitimate appellation). All that can be certainly said of it is that, amongst others, *C. Viticella* and *C. lanuginosa* hold a prominent place in its ancestry. The first is a European species producing an abundance of moderate-sized, rather dark-coloured flowers. The latter is a native of Japan, producing large pale-coloured flowers rather sparingly; it is the parent, more or less remote, of most of the garden hybrids raised within the past ten years. It is from these sources, therefore, with probability, that *C. Jackmanni* derives its good qualities. In another hybrid, where, it having been raised by an amateur horticulturist, the history is known, the relation of the qualities of parents and offspring is all but inexplicable. Mr. Anderson Henry crossed *C. lanuginosa* already alluded to, which bears pale lilac flowers as much as eight inches across, with *C. Fortunei*, also of Japanese origin, with white flowers rather smaller and of a different character. He obtained, amongst other forms, *C. Lawsoniana*, which possesses flowers as much as *nine and a half* inches across, and of a *rosy purple*; yet it could not possibly owe either its size or colour to its immediate parents. That questions of this kind should be dealt with in what is after all a purely horticultural work, is a striking proof of how little reason there really is to despair about the general interest excited by scientific work. The whole of horticulture is, in a sense, a vast field of biological research, with results all ready to hand. It is due entirely to Mr. Darwin that the attempt has been made to gather them in. Perhaps the authors will hardly care, at least at present, to have their book stigmatised as too scientific. It contains all that can be desiderated of the pure gardening of its subject, and is capitally illustrated with plain and coloured illustrations.

W. T. T. D.

Synopses of Subjects taught in the Geological Class, College of Physical Science, Newcastle-on-Tyne, University of Durham. By David Page, LL.D., F.G.S. (Edinburgh and London: Messrs. Blackwood)

THESE Synopses are most comprehensive, and will, we are sure, be of some value to students and science-teachers. They embrace the subjects taught in the junior and senior divisions of Dr. Page's class. In the former division the subjects follow each other thus:—Physical Geology, Elements of Biology, Physical Geology and Lithology, and Descriptive and Historical Geology. Under the heading of "Senior Division," we find Physical Geology and Mineralogy, Mineralogy, Descriptive Geology and Palæontology, Palæontology, and Economic Geology. The Synopses are characterised by the same clearness and precision for which Dr. Page's text-books are so justly noted. On glancing over the pages, we were surprised to find in the "Tabular Synopsis of European Formations" a "Metamorphic System" underlying the Laurentian, and an "Azoic Cycle," preceding the Palæozoic. Now there may be a Metamorphic System of older date than the Laurentian rocks, and strata deposited during "Azoic" times may also exist; but at present we have no knowledge either of the one or the other. Murchison, we thought, had settled once and for ever that the crystalline schists of the Scottish Highlands were of post-cambrian age. J. G.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The National Herbarium

PERMIT me, in your columns, to give shortly the grounds upon which I made the statement that no herbarium of any kind existed at Kew Gardens during the time of the Aitons, but that the Banksian Herbarium was often, and for a long time systematically, used for naming the Kew plants (NATURE, Oct. 3, 1872, p. 450), which statement is thus dealt with by Dr. Hooker (NATURE, Oct. 24, 1872, p. 516):—"Nor was the naming of the Kew plants carried out in London, as is supposed. There was a large herbarium in constant use at the Royal Gardens at the very period alluded to, the breaking up of which, when it was proposed to give up the Gardens, necessitated the formation of another."

Instead of my statement being a supposition, it was based on the following data:—1. The lists of the plants sent up from Kew Gardens to be named by Solander when Curator of the Banksian Herbarium, which were duly entered in the "garden book," still preserved in the Botanical Department here. 2. The continuance of this practice to a recent date, as evidenced by the following article in the engagement between Mr. Brown (Solander's successor in the Banksian Herbarium) and the trustees of the British Museum when he became keeper of this department in June 1872, "that Mr. Brown have full liberty to assist the Superintendent of the Royal Botanical Gardens at Kew, in like manner as during the lifetime of Sir Joseph Banks." 3. The specific statements in several official reports of the late Sir W. J. Hooker, such as this from one dated 31st December, 1854:—"Till 1853 our garden was utterly destitute of the two former appendages," viz., an herbarium and library.

I was surprised to read Dr. Hooker's declaration that his evidence is "unequivocally opposed" to the transfer of the collection of dead plants from the British Museum to Kew. In this case I have completely misunderstood his position in the repeated attempts that have been made to destroy the scientific position of the National Herbarium at the British Museum. In 1858, when the trustees of the Museum were induced to inquire into the necessity for the existence of the herbarium in London, they examined Dr. Hooker among other witnesses, and in their finding they say, "Sir W. Hooker, Dr. J. Hooker, and Dr. Lindley have given reasons in favour of the removal of the collections from the British Museum to Kew, with the view of rendering that establishment more complete." Other testimony, however, had more weight, and so they were "unanimously of opinion that it is not desirable to recommend the translation of the botanical collection from the British Museum to Kew." (Return, House of Commons, 1859, No. 126, p. 12.) Ten years after, in the memorial presented through the Board of Works to the trustees, Dr. Hooker proposed that a "Reference Herbarium," consisting of the "British Museum Herbarium, *minus* the specimens required for Kew" should be kept at the Museum for the use of "botanists, geologists, amateurs and others resident in London, or passing through it, who may want information which it would not be worth their while going to Kew to procure." And more recently, in his evidence before the Science Commissioners, Dr. Hooker repeats this proposal with somewhat more of detail. The great scientific working herbarium to which all botanists should come should be at Kew (Q. 6,683). To secure this, "the two herbaria should be arranged under one head" (Q. 6,685). "I could bring the collection under one system" (Q. 6,730). It would be the duty of the first herbarium in the country (*i.e.* Kew) to supply the British Museum (Q. 6,745). The specimens, "on their arrival at the British Museum, could be put into their places by the officers there, the operation being as simple as that of putting books on a shelf;" and in future "a subordinate could intercalate the additions" (Q. 6,732).

No doubt these proposals (excluding that made in 1858, on the death of Mr. Brown, and before the appointment of Mr. Bennett), contemplate the maintenance of a collection of dead plants in London. But a collection from which "all specimens of interest only to the scientific botanist have been removed to Kew" (NATURE, vol. iii. p. 401), and consisting only of the worthless duplicates of the two amalgamated herbaria, would be utterly useless for scientific purposes, and its maintenance would unquestionably be a waste of public money.

I will only add, that there is certainly nothing to prevent Dr. Hooker "recruiting" the British Museum Herbarium from that at Kew to any extent, at once, and without the intervention of a Royal Commission. It is quite certain that the trustees and my predecessors, like myself, would have welcomed sets of the numerous collections, made at the expense of the British Government, which have been distributed from Kew to "America, Paris, Austria, Prussia, Hanover, Holland," &c., but none of which have ever been sent to the National Herbarium at the British Museum! W. CARRUTHERS

British Museum, Dec. 2

THERE is no inconsistency between Sir W. Hooker's statement, quoted by Mr. Carruthers, that "till 1853 our garden was utterly destitute" of an herbarium and library, and mine that in the Aitons' time there was a large herbarium here, kept up for naming the garden collections. Sir W. Hooker of course referred to the period during which the gardens had been public property. The herbarium in question was broken up when Kew ceased to be a private establishment. The words quoted by Mr. Carruthers ought hardly in fairness to be detached from the context. Sir W. Hooker's meaning was, of course, that the gardens, as a public department, possessed, till 1853, no official herbarium or library. He goes on to speak of his own private ones, by means of which the work of the garden had been carried on ever since he became director, and which, having at his death been purchased by the Government, form, with those presented by Mr. Bentham and others, the foundation of the present collections.

It is necessary to mention this, as otherwise Mr. Carruthers' quotation might lead anyone unacquainted with the facts to suppose that the work of Kew Gardens up to 1853 had been conducted without any herbarium or library whatever.

Mr. Carruthers is mistaken in implying that I ever suggested the supplying the British Museum with "worthless duplicates" from Kew; and equally so in stating that "none" of the collections distributed here have ever been sent to the British Museum. Such an assertion is no encouragement to send more. Nor does the fact that no return of any kind has ever been made by the British Museum for some thousands of specimens that have been sent to it from Kew, offer much inducement to continue such gifts. It is the clear duty of this, as of other similar establishments, to distribute its duplicates to such institutions as exert themselves to make a suitable return. This is the case with the Herbaria of America, Russia, Prussia, Holland, &c., and, in fact, with all kindred establishments with which Kew corresponds. It is the acquisition by this means of authenticated specimens from almost every seat of botanical research, which more especially gives to the National Herbarium of Kew Gardens the incomparable position it now holds. JOS. D. HOOKER

Royal Gardens, Kew, Dec. 3

The Meteoric Shower

WHILE the observations of the recent meteoric shower continue to attract general attention, the following notes of some descriptions of the display that have reached me, which will contribute useful results for comparison with published accounts of the phenomenon that have already appeared, will, perhaps, be interesting to your readers:—

On the nights immediately preceding that of the star-shower the sky was at some places unclouded, and observations of meteors were recorded. The large meteor described in a recent number of NATURE as having been seen by Mr. Denning at Bristol on the evening of the 23rd ult., as well as a single other shooting star noted during a watch of the sky whenever it was clear by the same observer on that evening, seem, from their apparent courses, to have been both possibly directed from the now well-known radiant point of the meteors of Biela's comet, but only a small number of shooting stars appears to have been visible on that night. During a watch for ten minutes, kept at four different times between half-past 7 and half-past 9 P.M. on the following evening, near Regent's Park, in London, Mr. H. W. Jackson observed, in each watch, a shooting star as bright as a first-magnitude star directed in each case from the recently determined radiant point; while, with an equally uncloudy sky, on the following evening of the 25th, three small meteors from the same radiant point, and two brighter ones from other directions, were seen by Mr. Denning at Bristol between 8 and 11 P.M. in two intervals of a watch for half an hour. A small meteor of the same stream was recorded by Mr. Denning on the 26th, but their numbers on this, as on the previous nights, were evidently inconsiderable, a clear view of the sky on the night of the 26th, between 11h. 20m. and 12h. 40m., affording Mr. Jackson, at Tooting, no observation of a single meteor. The time of first approach and commencement of the bright star-shower seen on the evening of the 27th ult. must therefore have been later than shortly before 1 o'clock on the previous morning. A completely overcast state of the sky after midnight on the night of the shower appears to have prevented observations of its close, and probably of its complete extinction on that night, after the greatly-diminished intensity which it had then attained; but a correspondent in London informs me that, in spite of the densely overcast state of the sky, which prevented any view of the shower from being obtained in the metropolis, an exceedingly bright meteor was seen to flash like lightning through the clouds at about 4 o'clock, A.M., on the 28th. On the evening of the 28th Mr. Greg watched for shooting stars, and for any remnants of the star-shower of the previous evening which might be visible, at Buntingford, in Herts; but although the sky was quite clear he failed to see any meteors. A strict watch for outlying meteors of the shower was also kept by two observers at Hawkhurst, in Kent, on the evening of the 28th, where the sky was quite cloudless between 9h. and 11h. 15m. P.M., but without success, only four shooting stars of ordinary character being visible during more than two hours of their simultaneous watch. An interval of about forty-four hours is thus clearly determined in which the first indications of the star-shower must have arisen, reaching the maximum of its intensity towards the middle of the period, and disappearing so completely before its termination as to leave the whole expanse of the sky almost as perfectly free from shooting stars as it was before its commencement.

In addition to the early appearance of the shower recorded in NATURE of the 5th inst. as having been seen near Dublin, I have received the following communications from observers relating to its early visibility and abundance. At Brancepeth, near Durham, Mr. Joseph Lawson first began to count the meteors at 5 o'clock, and continued to enumerate them until, towards 7 o'clock, their constantly increasing frequency obliged him to desist. During the last half hour of his estimation the rate of their appearance was about ten per minute, while a total number of 1,000 meteors was counted between 5 and 7 o'clock. The rate of their appearance in the first was thus little less than that of their appearance in the latter portion of his watch. Mr. S. J. Miller, at Wisbeach, first noticed the abundance of shooting stars at 5h. 40m., and counted in three minutes twenty meteors, or about six or seven per minute. Soon after this, at about 6 o'clock, their number was ten or twelve per minute. During their appearance before 6 o'clock, Mr. Wood, at Birmingham, considered them to be falling from 5h. 45m. when he first observed them, at a rate of about fifteen per minute, while the result of his enumeration between 6h. and 7h. was at least 600 meteors, and in occasional intervals between 6h. and 7h. 15m., when the sky became gradually overcast, the average rate of appearance was found to be increasing nearly uniformly from 8 to 10 per minute, showing that the intensity of the display before 6 o'clock was little inferior to the maximum which it appears afterwards to have gradually attained. At York the first attempt to estimate their numbers was made by Mr. T. H. Waller, at 5.30 o'clock, when the meteors were found to be appearing at the rate of 12 or 15 per minute. At 6 o'clock their numbers had increased to about 20, and at 7 o'clock to about 30 or 40 per minute for one observer. At 8 o'clock the best determination of their numbers was however obtained by two of Mr. Waller's scholars, who, standing back to back, counted 79 meteors in 1m. 15s. or 31 meteors per minute for each observer. The principal maxima of the shower at about 6h. 30m., and 8h. 15m. P.M., as mostly clearly shown by the continuous observations of Mr. Lowe at Highfield House, and by Prof. Grant, who was assisted in his observations at the Glasgow Observatory by Prof. G. Forbes, are also generally indicated by the observations which I have received, and the gradual diminution of the shower after 9 o'clock was observed at Newcastle-upon-Tyne as well as by some of the observers who combined in their watch for its appearance for the British Association. The frequency of the meteors after 9 o'clock was regarded by Mr. Wood as not more than a quarter of what it was at about 6 o'clock, when they were first seen, yet these numbers continued for some time to be considerable and quite unusual. Near Rothbury, in Northumberland, repeated estimations of their abundance were made by Mr. G. A. Lebour in different parts of the sky, and at different times between the hours of 7 and 10 o'clock, with the following results:—

From	$7^h\ 20^m$	to	$7^h\ 28^m$	100 meteors falling perpendicularly in the west (the east cloudy).
	7 35		7 40	100 meteors falling vertically in the east (the west cloudy).
	7 45		7 48	100 ,, ,,
	9 0		9 15	Meteors too numerous to count at 9h., falling in showers at 9h. 15m., especially in the north; one bright red with beautiful red streak, which lasted more than 10 seconds.
	10 0			Meteors still falling, but in smaller numbers.

In 20 minutes after 10 o'clock 35 meteors were seen by one observer in a clear part of the sky, which scarcely exceeded a quarter of the sky. In 10 minutes after 11 o'clock ten meteors only were counted in the same space, and in 20 minutes after 12 o'clock 9 meteors only could be seen. The rate of decrease of the shower from shortly before 10 o'clock until after midnight was thus apparently more rapid, and the decline of its intensity appears to have been considerably more complete than the first brightness and progress of its gradual increase may be concluded to have been during the earliest hours of its observation.

Newcastle-upon-Tyne, Dec. 7 A. S. HERSCHEL

The De Novo Production of Living Things

WILL you allow me to ask Dr. Bastian to state in your columns, in reply to this note, the specific gravity of the turnip infusion, to which a "fragment" of cheese has been added, and which, he states, has rarely failed to give him positive results in his endeavours to obtain evidence of the *de novo* production of living things from dead matter. If Dr. Bastian should be unable to give the specific gravity of the infusion, perhaps he will be so good as to state accurately the weights of water, turnip, and cheese employed. I am, of course, acquainted with the directions he has already given, but wish to avoid any objection from him or others on the score of improper preparation of the infusion to results which I may obtain and publish.

E. RAY LANKESTER

Exeter College, Oxford, Dec. 7

The Birth of Chemistry

YOUR correspondent, "A. H.," in alluding to my mention of the *Insulæ Cassiterides*, inquires whether the name was derived from a Sanskrit source. The word *κασσίτερος* is used both by Homer and Hesiod, and it is possible that it may have been borrowed from the Sanskrit *kastīra*, and that tin was first procured from India. The Sanskrit word for tin—*kastīra*—is clearly related to the verb *kās*, to shine. It is strange that the Arabic word for tin is *kāsdir*, closely resembling the Sanskrit, although there is no family relationship between the languages. Possibly the Phœnicians first procured tin from India, and gave it a name resembling its native name *kastira*; then the Greeks converted the Phœnician word into *κασσίτερος*, the Romans borrowed the word from the Greeks, and the fact of the scarce

metal being found in certain islands north of Spain was sufficient to secure for them the distinctive title of *Insulæ Cassiterides*, or Tin Islands.
G. F. Rodwell

The Greenwich Date

Under this heading, in your number for Nov. 28, a letter signed "James Pearson" ends thus:—"The query then is—in what part of the globe and in what meridian does October 20 end and October 21 begin?" As well ask where a circle ends and where it begins. See an article at the end of Bayle's Dictionary, entitled, in the second Rotterdam edition, 1702, "Dissertation sur le jour," vol. iii. p. 3118; in the London edition, 1741, "Dissertation concerning the Space of Time called Day," vol. x. p. 365. The difficulty, as Bayle shows, is in the nature of things. Let an equatorial railroad go round the world in twenty-four hours, with a station at every 45th meridian. At noon of October 20, Mr. West takes "a return ticket" westward; Mr. East takes one eastward. Both reckon by solar time. At every station Mr. West finds it noon, and on his return home reckons noon October 20; but the station-master reckons noon October 21. Mr. East at 45° sees the sun set at 6 o'clock. At 90° he finds midnight; at 135° the sun rises at 6 o'clock on October 21; at 180° it is noon. Here the two passengers pass each other, Mr. West reckoning it to be noon of October 20, Mr. East noon of October 21. At 135° W., Mr. East sees the sun set; at 90° he finds midnight; at 45° the sun rises at 6 o'clock on October 22. On his return home Mr. East reckons it to be noon of October 22. Here then are three different reckonings, and practically the keeping of Sunday, Christmas Day, &c., on different days in different countries exists at this instant and must exist for ever. Practically also those who sail eastward round the world get one more dinner than those who stay at home. Those who sail westward round the world get one dinner less than those who stay at home, and two dinners less than those who sail eastward, when both voyages are completed.

George Greenwood

Brookwood Park, Alresford, Nov. 30

Mr. Pearson's query, in Nature of November 28, does not admit of any exact or scientific answer, for there is no natural line of demarcation or change, and the settlement is entirely a matter of usage or convenience. It is not very many years since the dates at Manilla and Macao were different; and till the cession of the Alaska Territory to the Americans, the date there was different from that in the British Territory adjoining. The rule now generally held is, that places in E. long. date as if they were arrived at by the Cape of Good Hope, and places in W. long. as if they were reached *via* Cape Horn—a rule that the width of the Pacific renders practically convenient. Afloat, the rule is for a ship making a passage to change her date on crossing the meridian of 180°, or as soon after as the captain may find convenient; repeating or omitting a day, according to the direction in which she is going; but a ship merely cruising across the meridian, with the intention of returning, does not generally change her date, so that ships having different dates may and do occasionally meet—a very marked instance of which occurred during the Russian war, when our squadron from the Pacific joined the China squadron on the coast of Kamschatka.

And thus, according to established usage, October 21 at Adelaide, and October 21 at the hypothetical place in 9h. 35m. W. long., are different days; in the two places October 21 has a different meaning.

J. K. Laughton

Royal Naval College, Dec. 1

The Rev. J. Pearson is correct in the method of finding the corresponding Greenwich date, although its numerical performance is incorrectly performed in his letter.

It is absolutely necessary for practical purposes to draw the line somewhere, and it is drawn in England an her colonies as well as in America and Russia, at the meridian 180° E. of Greenwich. The limit, therefore, of the longitude to be added to or subtracted from the Greenwich date will not exceed twelve hours.

It is usual for sailors, when crossing this meridian, to skip a day, or to reckon the same day over again, according as the meridian has been reached from the eastward or westward.

An instance of this apparent anomaly is furnished in the Appendix to the "Nautical Almanac" for 1874. The time of the phenomenon of the transit of Venus over the sun's disc takes place generally about December 8, 16h. Greenwich astronomical time. Its recorded local astronomical time for the middle of the transit at Auckland, New Zealand (long. 174° 42′ E.), is December 9, 3h. 40m.; but for Woahoo (long. 158° W.) the time of the first contact of Venus with the sun's limb takes place at December 8, 3h. 4·7m.

Edward Roberts

Blackheath Road, Greenwich, Dec. 2

Comets' Tails

Can any of your readers refer me to a work by a recognised authority in astronomy in which I can find the method by which the direction of a comet's tail, as regards that of the heliocentric radius-vector of the head, has been calculated from observation? Or, more briefly, have we *any proof whatever* that there is other than an occasional chance coincidence of these two directions?

G. H.

REMARKS ON THE ZOOLOGY OF THE FAROE ISLANDS

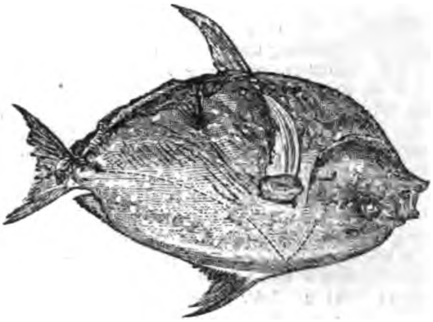
As I have already announced in this paper, I started with the Danish expedition in September from Copenhagen, and arrived after a very fortunate voyage of four days in Torshavn, the little capital of Faroe in the isle of Strömö. There I intended to remain while our steamer, with the geologists and engineers, went to the southern island (Suderö), where the miocene coal deposits are to be seen some hundred feet above the level of the sea in the basaltic rocks near the village of Qualbö. As to their researches about the extension of the coal-fields in Suderö, directed by Prof. Johnstrup, and as to the possibility of taking the coals over to Copenhagen at a reasonable price, I cannot say anything now, as the report must first be made to the Minister of the Interior, who will perhaps afterwards publish the results. Some words, however, about my own zoological researches in Torshavn will, I think, have some interest for the readers of Nature.

I remarked in my preceding paper that no wild mammals were known to occur in the islands, except some species of the genus Mus. This is, as I now know, not quite correct; for some thirty or forty years ago the northern hare (*Lepus alpinus*) was introduced into the islands, and it seems to have met with very favourable conditions of life, as it is now spread in considerable numbers over Strömö, and has also been brought to Oesterö. The hare finds ample food in the grasses covering the ground; the large rocks spread everywhere protect him, and no mammals or birds of prey endanger his life, with the exception of *Corvus corax*, or the little *Falco æsalon*, which sometimes might take the younger ones. The occurrence of the *Falco islandicus* is too rare to do any serious damage to the hares. Besides these, they have also endeavoured to introduce the "ripers" (*Tetrao lagopus*) so common in Iceland and Norway, but those set free have perished without breeding. These birds require food and protection from trees, which, as it is known, do not occur in these islands.

The rats found in the northern islands of Faroe (although they have not yet come to all the islands) belong to the species *Mus decumanus*, which here, as nearly everywhere in Europe, has nearly destroyed the smaller black rat (*Mus rattus*), still, however, to be found in some houses of Suderö. In the "fields" still another species of rat is said to occur, not heretofore seen by naturalists. Mr. Randrop of Torshavn, who has taken great trouble in order to secure a specimen of the animal, the footsteps of which he has seen, thinks it is the *Lemmus norvegicus*, but he could never get it. Among the large aquatic mammals the "Grindehval" (*Delphinus globiceps*) is known to be of great importance here, as nearly every year large flocks of it are taken, which they drive to the shore by boats, and the flesh of which is divided after old northern laws still in use in this country. Some hundreds of this whale had just been killed in Westmannshavn (west side of Strömö) some days before we arrived, and I still could examine pieces of the animals brought to Torshavn. I immediately looked after external parasites, but would not have got them if Sysselmand Müller, the well-known magistrate and naturalist of Torshavn, had not had the kindness to give me some specimens. These are two species of Cirripedia, one of them being an *Otion*, which often attaches itself to the teeth of the dolphin, where it easily finds food; as the surface water, coming in, is full of little creatures (infusoria, crustacea, &c.), which the Otion catches by aid of its arms. Another very interesting external parasite of the dolphin is the *Xenobalanus globicipitis* Steenstr., which Sysselmand Müller has discovered in large numbers on the fins of the whale. An allied species, also described by Steenstrup, is found on the fins of *Uranodon rostratus*, a whale met with in small flocks of four and five, especially near the southern island, where one of them was killed during the stay of the expedition. In Torshavn I also sought to get the intestines of the grindehval; but these, of course, had already been thrown into the sea, with the exception of the stomach, in which I have found the rests of Cephalopods, the usual food of this whale, and the common Ascaris.

At the time when we arrived in Faroe the celebrated "Fuglebjergs" (bird-rocks) were unfortunately already deserted by their inhabitants, so that I have seen nothing of their extraordinary life. Of one of them Sysselmand Müller has taken up excellent photographic views (Trollhovedet, near Sandö), which give a very good idea of them, and deserved to be published in an ornithological work. We see in it clearly the different stages which the birds occupy in the rocks, the highest of them being the sea-parrot (*Mormon fratercula*), then a *Larus*, and undermost *Uria*. Only the little *Thalassidroma pelagica* was said to be still breeding (September), and I therefore resolved to see the nests. In the rocks of the north-eastern side of Naalsö these little birds breed in a depth of one or two feet, their nest being simply a hole in the earth. One of the natives lifted the stones for me, then bent his ears to the holes, and, when he heard the birds piping, broke them up. In this manner we took an egg containing an embryo, with the old bird, which did not even endeavour to run or fly away, and three younger ones in different stages of growth. The Thalassidromæ have only one egg, but they seem to breed twice or thrice a year. In the neighbourhood of this place, they told me, the nests of *Procellaria glacialis* were also to be found. Besides these, the birds usually met with were *Authus campestris*, *Saxicola œnanthe*, *Motacilla alba*, *Troglodytes parvulus*, *Tringa variabilis* and *islandica*, *Numenius phæopus*, and *Hæmatopus ostralegus*, *Carbo*, *Sterna*, *Larus*, &c. We also got some living specimens of *Sula alba*, only occurring in the island of Myggenaes, and of *Lestris cataractes*, now not very common in Faroe, for the Zoological Garden in Copenhagen. Occasionally they have also taken the *Pastor roseus* and once *Syrrhaptes paradoxus*. The former bird is known to appear sometimes in Norway and Heligoland (nearly every summer)—a very remarkable fact, as these birds, which are known to breed in Southern Russia and Asia Minor, have so very seldom been met with in Denmark or in the interior of Germany.

Fishes are caught abundantly on the shores of Faroe; so that, for example, the klippfish trade is very considerable. The *Gadus* are opened, spread out and dried on the rocks (klipps), and are exported to Spain and France, their swim-bladders being used for the fabrication of gelatine, and their ovaries being prepared for the use of the anchovy fishers in the Mediterranean. Of remarkable fishes only the *Lampris guttatus* Brünu was taken during my stay in Faroe, inhabiting the great depths of the Atlantic, and coming only by accident to the shores of these islands. This was the third specimen taken there, an enormous creature, weighing 76 Danish pounds, having a length of 99 centimetres, and a breadth of 52. The colour was a magnificent silver blue with red spots; it had been taken by the fishers in the King's Harbour (Kongshavn), and was admired, when brought to Torshavn, by large crowds of people who had never seen it. Before dissecting it, Sysselmand Müller took a photograph, which has been reproduced in the accompanying woodcut. We then separated the principal muscles from the bones (the flesh looked like salmon's, but its taste was not quite so good), in order to get the skeleton, and I dissected the intestines. In the stomach I found the same remains of Cephalopods, which also Kröyer mentions (in "Danmarks Fiske") in the specimens he examined. Of the internal parasites I may here only mention an agamic Ascaris in the outer walls of the stomach, and a cestoid in the *intestinum tenue*. External parasites were eagerly sought for, but not found.



Lampris guttatus

Very interesting to me were the lakes in the interior of the islands, as I hoped to get there something like those animals ("relicts") found in the lakes of Sweden and North America. I accordingly dredged in one of them, but did not find anything of importance. I also examined the three species of Salmonidæ of these lakes, one of them being the *Salmo salvelinus*, known to to be found in the lakes of Upper Bavaria and of Scotland. More about these inhabitants of the Faroe lakes may shortly be seen from a paper which I am to publish in v. Siebold and Kölliker's *Zeitschrift*; and the same periodical will also contain the results of my investigations on the Annelids from the shores of Faroe, which formed the principal object of my researches. I may here only remark that, on the whole the invertebrate fauna of the shores of Faroe, as well as of Iceland, is very poor compared with that of Greenland, Norway, or Denmark; so that the place is not to be recommended to those who wish to get in an easy manner favourable objects for anatomical or embryological observations. When I was there the currents were sometimes so strong that, even with the heavy oyster-dredges of Jutland, we did not reach farther down than 15 or 20 fathoms. And as to the surface-fauna, it was, with the exception of some few days, quite impossible to do anything, as the sea was too much agitated. In midsummer, of course, all those obstacles will vanish. Nevertheless, I could every day get fresh materials, as when the sea was rough I was sitting on the rocks of the shore, and selecting the animals from the sand and sea-weeds brought up in the harbour of Torshavn by my fisher, Zacharias Hansen, a very brave man, whom I recommend to every naturalist coming to Faroe in the future. With respect to comfort, my stay in the island was very agreeable, thanks to the care which Mr. and Mrs. Hansen were always good enough to take of me.

RUD. V. WILLEMOES-SUHM

THE SHERMAN ASTRONOMICAL EXPEDITION

BY the courtesy of Prof. Peirce, Superintendent of the U.S. Coast Survey, I am permitted to lay before the readers of NATURE, at the request of its editor, a brief account of the operations and results of the party which was stationed during the months of June, July, and August last at Sherman, the summit of the Union Pacific Railway.

The expedition was organised under the auspices of the Coast Survey; the observations, other than those for determining the mere geographical and topographical constants of the station, being provided for from a special appropriation of 200,000 dols. granted by Congress, at the request of the Superintendent, and placed at his disposal for the purpose of securing a series of astronomical and meteorological observations at some elevated point on or near the Pacific Railway.

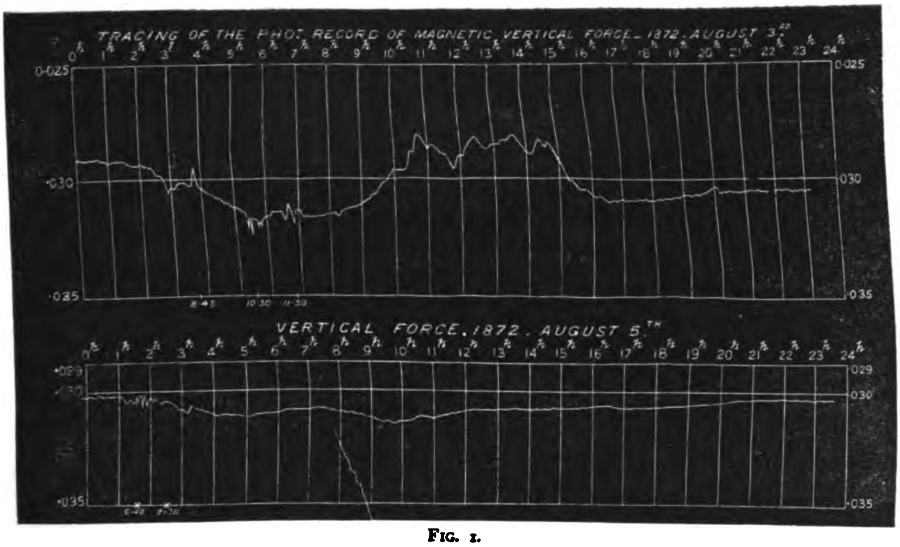


FIG. 1.

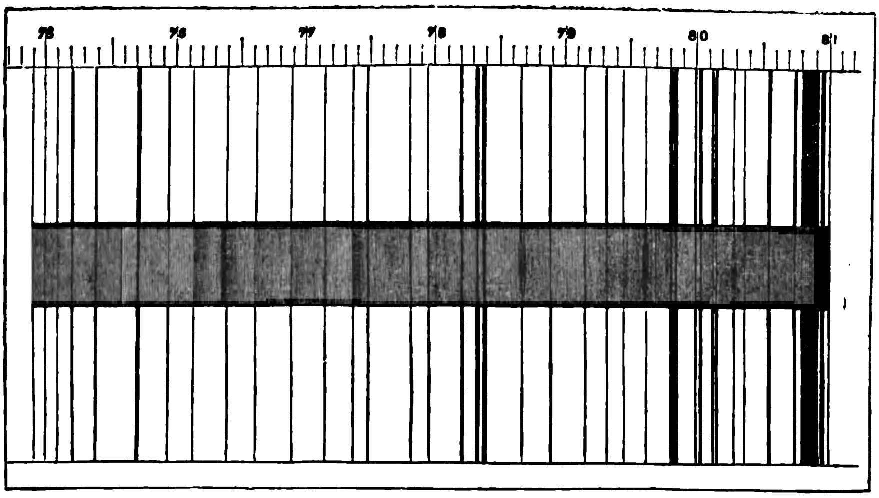


FIG. 2.—Spectrum of a Solar Spot.

The party was under the charge of General R. D. Cutts, one of the most experienced officers of the Survey, and consisted of himself, Assistant Mosman, and Aid Colonna, with myself, my colleague Prof. C. F. Emerson, who was kind enough to act as my personal assistant, and a young friend, Mr. C. K. Wead; we had also a photographer, a mechanician, and a couple of servants. A detail of about a dozen of the most intelligent soldiers from Fort D. A. Russell at Cheyenne served as an escort, and were invaluable in keeping up the hourly series of meteorological observations, and in many other ways, as well as in protecting us from any undesirable attentions of our red brethren; not that the protection was ever actually needed, for we hardly saw half a dozen Indians during the whole summer, except as passengers upon the railway trains.

The station was established in June, but it was not until July that I was able to join the party with Prof. Emerson and Mr. Wead. Our instrument had been forwarded by express, and was already on the ground. It was the Dartmouth College equatorial, having an aperture of $9\frac{4}{10}$ in., with a focal length of 12 ft., provided with clockwork and all the usual accessories, and fitted with an automatic spectroscope having the dispersive power of 13 prisms. The instrument was loaned for the occasion by the trustees of the College, who, for the good of science, have never hesitated to send their most valuable apparatus to any portion of the earth; and thus far, I am happy to say, have met with no loss in so doing.

Our observatories, one for the transit instrument, one for the meteorological apparatus, and one for the equatorial, were "shanties" of rough boards, placed upon the summit of a slight elevation, some 150 yards S.E. of the railway station, and some 40 or 50 ft. above the track. The altitude of the observatory was about 8,300 ft. above the sea; the approximate latitude was 44° 7′; the longitude about 1h. 53·2m. west of Washington, or 7h. 1·4m. west of Greenwich. I give only approximations, the accurate reduction of the observations being not yet completed.

To the east the horizon was bounded by hills of no great apparent elevation, nor was there anything in the general aspect of the nearer landscape to remind the careless observer of his altitude. To the north, at a distance of about three miles, but seeming not more than half a mile away, rose some picturesque piles of granite several hundreds of feet in height; to the north-west lay the so-called Laramie hills; and from the north-west to the south, across the broad green Laramie plains, toward the mountains, many of them capped with perpetual snow. In the south were Long's and Gray's peaks, some 60 miles away; nearly west lay somewhat nearer the great mass of Medicine Bow; and between them, over the lower ridges, rose some of the high mountains of the Colorado parks. None of these snow-capped peaks have an elevation of less than 13,000 ft., and several exceed 14,000.

Our principal object was to ascertain what advantage would accrue to astronomical, and especially to spectroscropic, work, by placing the instrument at a great elevation. Theory declares that the gain ought to be great, since it is certain that our atmosphere, by its continual currents, its impurities, and its reflective power, is a most serious hindrance to telescopic work, and at the height of 8,000 ft.—more than a fourth of the whole is left below. The experiment of Prof. Piazzi Smyth, in 1856, on the Peak of Teneriffe, had already given a practical demonstration of the fact, so far as relates to ordinary telescopic work; but that was before the day of spectroscopy.

Although, on account of unfavourable weather, the amount of work accomplished was to some extent diminished, the results obtained were of considerable interest and value.

In the first place, the geographical co-ordinates of the station were completely determined; so that henceforth it will be a reference point and base for all the numerous surveys, geological and others, which are going on in that part of the country.

Then a complete hourly meteorological record was obtained for nearly the whole of the months of June, July, and August, a record which, from the exceptional character of the station, on the very back-bone of the continent, must possess the highest value, unless the fact that the season was also an exceptional one should prevent us from applying confidently to other years the conclusions it would indicate.

If we may credit the residents of the country, especially an old trapper who had lived among the mountains for nearly twenty years, the amount of cloudy and rainy weather during the summer was most unusual. Deducting a single week, during which every night and the greater part of every day was fine, clear nights were very rare, and clear days only a little less so. Indeed during our whole stay there were but two afternoons during which work upon the sun could be kept up uninterruptedly from noon to sunset, though during the same time there were more than twenty mornings.

Undoubtedly the explanation of this state of things is to be found in the enormous quantity of snow which fell last winter, and was still, in the middle of July, lying 8 ft. deep on the plateau at the base of the Medicine Bow mount.

Whenever the sky was unclouded the air was usually of most exquisite transparency. At night multitudes of stars, invisible at lower elevations, were easily seen; so that it was estimated that nearly all the stars of the seventh magnitude were fairly within reach of the naked eye. For instance, in the quadrilateral which forms the bowl of the "Dipper" I could see distinctly nine stars, with glimpses of one or two more, while at home I can only perceive the three brightest of them.

The power of the telescope was correspondingly increased. Without being able to devote a great deal of time to stellar observation, I ascertained that, with my 9$\frac{4}{10}$ inches of aperture, nearly everything could be fairly seen which, at the sea-level, is within the reach of a 12-inch object-glass.

Some most exquisite views of Saturn will always be remembered, in which, notwithstanding the planet's nearness to the horizon, the inner satellites, and the details and markings of the rings, especially a dark stripe upon the outer ring, about a third of its width from the outer edge, were clearly shown under powers ranging from 500 to 1,200.

But in the use of the spectroscope the advantage was even greater. At Hanover I had been able to make out a list of 103 bright lines in the spectrum of the chromosphere; at Sherman the number was extended to 273; and at moments of unusual solar disturbance there were glimpses of at least as many more.

Sulphur, strontium, and cerium are pretty conclusively shown to be constituents of the solar atmosphere. Zinc, erbium, didymium, and iridium are also indicated, but not so certainly.

At the very base of the chromosphere, and to a distance of perhaps 1″ or 15″ from the edge of the photosphere, it was found that those dark lines which are not actually reversed lose their intensity, and vanish more or less completely. This is substantially a confirmation of an old and somewhat disputed observation of Secchi's, who reports at the edge of the sun a layer giving a continuous spectrum.

This is not strictly correct, however, since when the transparency of the air is so much increased as to cause the most persistent of the dark lines to vanish, a multitude of the others appear reversed. There can be little doubt that were the effect of our own atmosphere entirely removed, this lowest portion of the solar atmosphere would give the same spectrum of bright lines which is seen at the beginning and end of totality during an eclipse.

It is noteworthy that of the 170 new lines found in the chromosphere spectrum, not a single one lies below C, and that for no want of careful examination. The only new lines of much importance are the two Hs at the extreme violet end of the spectrum. These were found almost constantly reversed, probably quite so, but the observation was so difficult that we could not be perfectly sure of it on every occasion.

What is still more remarkable, it was found that these two lines (not the hydrogen lines, as has been erroneously reported) are also usually, and I am pretty confident always, reversed in the spectrum of sun-spots, not so clearly, moreover, in the nucleus as in the penumbra, and over a somewhat extensive region surrounding it. This reversal of the H lines does not involve at all the disappearance of the dark shade, but a bright streak rather than a line makes its appearance in the centre of the shade, which itself is, if anything, a little intensified.

The spectra of several different spots were carefully studied, and a catalogue was drawn up of 155 lines which are more or less affected, usually by being greatly widened, but in some cases by a weakening or reversal. Several bright lines were also found in the spot spectrum, and between C and D some very peculiar shadings terminated sharply at the less refrangible limit by a hard dark line, but fading out gradually in the other direction at a distance of three or four of Kirchhoff's scale divisions. The interpretation of such markings is not quite clear, but would rather seem to point to such a reduction of temperature over the spot-nucleus as permits the formation of gaseous compounds by elements elsewhere dissociated, since these shaded spectra are quite probably characteristic of non-elementary substances, a view fortified by Schuster's recent beautiful investigations upon the spectrum of nitrogen.

Many more or less remarkable solar eruptions were observed, though none on quite so magnificent a scale as some before recorded. On several occasions velocities of from 150 to 200 miles per second in the ejected matter were observed by means of the displacement and distortion of the hydrogen lines, and on one occasion a velocity of nearly 250 miles was attained. One of the finest eruptions was visible on the surface of the sun itself in the immediate neighbourhood of a large spot.

A careful comparison of some of these observations with the corresponding magnetic records at Greenwich and Stonyhurst, for copies of which records I am indebted to the courtesy of Sir G. B. Airy and Rev. S. J. Perry, goes far to show that, although probably the *greatest* magnetic disturbances are due to terrestrial causes, or at least are only indirectly results of solar or cosmical influences, yet, on the other hand, every solar paroxysm does have a distinct, direct, and immediate effect upon the magnetic elements. Thus on August 3 such solar paroxysms were noted at 8.45, 10.30, and 11.55, also on August 5 from 6.20 to 7.30 A.M. (Sherman time), and the last was the only outburst during the day.

Now the annexed figure (Fig. 1), from a photographic copy of the vertical force curve for these days at Greenwich, shows marked and characteristic disturbances at the points indicated, which, allowing for the longitude, correspond to the very instants when the solar disturbances were noted. Further comparisons of such phenomena will be necessary to establish the conclusion with absolute certainty; but in the meantime it seems altogether probable that every solar disturbance receives an immediate response from the earth, and that the magnetic impulse travels with, sensibly, the velocity of light.

I must not close without alluding to certain observations that enable us to distinguish, to some extent, between the substances ejected from the sun, and those constituting the atmosphere into which the irruption takes place. Certain lines during these outbursts were distorted and displaced, while others near them, equally conspicuous, were wholly unaffected.

Thus on August 3 and 5, the former class included the lines of hydrogen, D_3, the lines of sodium, magnesium, and many of those of iron; in the latter were K534, 1474, 1505, 1515, 1528, 1867, 2007 (1870 and 200 were intensely disturbed), 2581, and probably the two Hs; I say probably, because the observation of these lines was too difficult to permit absolute certainty, still I feel very confident that they were unaffected. The barium lines also seldom seemed to participate in any disturbance.

The obvious moral of our summer's work seems to me this, that no time ought to be lost in occupying points of such advantage with the most powerful instruments: the great telescopes now building should be put in a position to profit by such atmospheric conditions as will secure their utmost efficiency, for while it is of little consequence to science whether ordinary glasses are placed where their power will be increased by 25 per cent., it may make a difference of years and decades in her advance if the new artillery opens its attack upon the heavens from the mountain-tops instead of from the plains.

Dartmouth College, Nov. 25 C. A. YOUNG

THE TRANSIT OF VENUS

AT the meeting of the Astronomical Society on November 8, a sketch was given of Lord Lindsay's preparations for the forthcoming transit of Venus. Lord Lindsay has selected the island of Mauritius as his station, on account of its highly favourable meteorological conditions. He intends, if possible, to combine the following methods of observation:—1. Observations of the internal contacts to be worked out on the plans of Halley and Delisle. 2. Observations of the first external contact at the chromosphere, to be made with the spectroscope. 3. Photographic pictures. 4. Heliometric measures. For the longitude it is at present intended to use the transits of the moon with an altazimuth made by Simms. As it is expected that the Germans will also have a station on the Mauritius, Lord Lindsay will connect his station with theirs by triangulation. The transit instrument is by Cooke, and has four inches aperture. The chronograph, which can be kept in motion for four hours, has four barrels, each of which can be worked separately, thus avoiding all confusion. The photographic method to be used is that of Prof. Winlock, who suggests a telescope of 40 feet focal length, placed horizontally, and a heliostat to reflect the sun's image along it. The lens is to be an achromatic one. It is intended to have two planes to the heliostat, one mounted on a polar axis, and another to send the rays down the tube. Lord Lindsay has ordered a Foucault siderostat with 16-inch mirrors, and has obtained a 13-inch unsilvered mirror to fit the telescope to be taken out. He intends to use a heliometer, though it is not much in favour in this country, Messrs. Respald, of Hamburgh, having undertaken to make one for him with all the improvements used in the Oxford instrument, as well as in some others. The Germans intend to send one to Kerguelen Land, and the Russians will use it at Lake Baikal and the mouth of the Amoor. Lord Lindsay's will include the motion of the halves of the object-glass in curved slides, so that the images will remain in focus; unlimited rotation of the tube in the cradle; the measurement of the position angle at the eye end, and measures of the micrometer read there also. Some new points are;—the graduation of the slides of the object-glass side by side, so as to be read by the same microscope; an arrangement to shut off light from half the object-glass, so as to equalise the light of the images; and the introduction of a thermometer at the end of the tube. Lord Lindsay proposes to eliminate errors of division as affected by temperature, by placing the instrument on one of the collimating piles of his transit circle at home, and heating the room by gas to different temperatures. It is hoped that, by taking a large number of measures, and by taking the most careful precautions, the original error of observation may be reduced to less than 0″·5, and thus make the result one of extreme accuracy.

Lord Lindsay will be glad to receive the advice and assistance of astronomers accustomed to use the heliometer. Mr. D. Gill will accompany Lord Lindsay, the two dividing the work of observing between them.

THE "CHALLENGER"

ON Friday last, Dec. 6, several members of the council and "the Circumnavigating Committee" of the Royal Society, by invitation of the Lords of the Admiralty, inspected at Sheerness H.M. ship *Challenger*, which sailed on Saturday on her three or four years' scientific circumnavigating expedition. The Government have all along consulted the Royal Society as to the fitting out of this expedition, and have liberally carried out every suggestion made by the Circumnavigation Committee. The visitors to Sheerness on Friday included many distinguished men of science, among them being Sir William

Thomson, Sir Charles Wheatstone, Prof. Huxley, Dr. Carpenter, Sir Henry Holland, Prof. Stokes, Prof. Allman, Dr. Hooker, Mr. Siemens, and others. Under the guidance of Captain Nares, the commander of the *Challenger*, Prof. Wyville Thomson, the scientific leader of the expedition, and other members of the staff, the visitors inspected with keen interest all the fittings and appliances with which the handsome ship has been furnished for carrying out the purposes of the expedition. Everything appeared complete, and the perfection and abundance of the preparations excited the universal admiration of the visitors. Government, in this instance, have acted with the most praiseworthy liberality. The ship itself has a greater tonnage than the three ships together which formed the expedition of Cook in 1772. After the visitors had completed their inspection, they were entertained to an ample luncheon in the wardroom, under the presidency of Captain Nares. A few toasts were drunk and a few very brief speeches made, in which some well-deserved compliments were paid to those most intimately connected with the expedition. Dr. Carpenter felt sure that under Prof. Thomson's superintendence "no fact would be let go, and that every fact would find its place and its value when results came to be worked out;" while Prof. Thomson said that if the vessel were not thoroughly equipped, it was the fault of the scientific staff; they had met with every encouragement from Government to ask for what is necessary.

We are sorry to hear that the *Challenger* has already met with a little rough treatment from some of the elements she is bound to explore. In the fierce gales which prevailed on Sunday, she lost her cutter, and was compelled to put into Deal. We believe no serious delay will result from this accident, which, we hope, may be the only one of the kind the party may meet with. According to present arrangements she leaves Portsmouth on Monday next.

We cannot, however, but express our regret that the party were allowed to set off on an absence from England which may be prolonged for four years, animated, in their voluntary exile, by no motive but a desire to promote the interests of science, without some more official and more extended acknowledgment from their scientific brethren throughout the country than a few after-lunch speeches on board the corvette. Our contemporary *Punch* has, however, given his accolade to the expedition in some spirited lines:—

> "Broadside guns have made room to ship batteries magnetic,
> Apparatus turns out ammunition,
> From main-deck to ground-tier I'm a peripatetic
> Polytechnic marine exhibition."

PROCEEDINGS OF ZOOLOGICAL COLLECTORS

MR. T. K. SALMON has lately transmitted to his agent, Mr. E. Gerrard, jun., of Camden Town, a fine collection of birds from the province of Antioquia, United States of Columbia. Amongst them are specimens of a new Humming Bird, which Mr. Gould has described as *Adelomyia cervina*. Mr. Salmon has now pushed forward into the upper valley of the Cauca, where he will enter upon untrodden ground.

Mr. Henry M. Whitely has also been very active lately in the district he is now exploring, in the Andes of Caravaya, east of Cuzco, Peru. His last collection contains some very fine species of Tanagers, previously only known from d'Orbigny's specimens in the Paris Museum. There are also several remarkable humming birds in Mr. Whitely's collection, one of which, being new to science, Mr. Gould has named *Iolæma Whitelyana*, after its discoverer.

Letters have been received from Mr. Charles R. Thatcher, who is *en route* for the Philippines, announcing his arrival at Yokohama, *viâ* San Francisco, and immediate departure for his destination. Mr. Thatcher will attend principally to the land-shells and birds of the Philippine Archipelago.

P. L. S.

NOTES

THE Italian Government has ordered a massive gold medal, with a suitable inscription, to be prepared for presentation to Dr. Livingstone. The medal was to be ready by the 3rd inst. and was to be consigned—with an official letter addressed in the king's name to the great traveller—to Sir Bartle Frere, in the hope that he may either present it in person, or forward it to him by some safe hand. The Commendatore Negri Cristofero, President of the Italian Geographical Society, has been the prime mover in bringing about the gratifying recognition of Livingstone's labours in behalf of Science and humanity; and the Italians generally appear to be delighted with the idea of being the first to tender him this national proof of the high estimation in which they hold him. On one side the medal bears the bust of the king, with the legend "Vittorio Emmanuele II. Rè d'Italia," and on the obverse "A Davide Livingstone, Vittorio Emmanuele II. 1872."

AT a meeting of the Geographical Society on Monday night, Mr. Francis Galton, who occupied the chair, stated that he believed Sir Bartle Frere would probably be in Alexandria that night, and that Lieut. Grandy, leader of the "Livingstone Congo Expedition," would land in Sierra Leone about the 15th of this month. Mr. Galton also announced that a long list of astronomical observations had been received from Livingstone by Sir Thomas Maclear, at the Cape, who says they will take three or four months to reduce.

WE greatly regret to have to record the death, on Monday last, of John Keast Lord, the manager of the Brighton Aquarium. We learn from the *Brighton Daily News* that Mr. Lord was laid up with a severe attack of paralysis some months since, but though it was known that he was not in the enjoyment of robust health, it was far from being generally thought that his indisposition would so soon be brought to a fatal termination. Originally a captain in the Royal Artillery, in which capacity he served in the Crimean war, and took part in the battle of Balaclava, Mr. Lord seems to have always entertained an intense love for the study of natural history; and at the close of the Russian campaign he quitted the army for a field in every way more congenial to his tastes. He now devoted himself to the study of nature in good earnest, and spent some time in Vancouver Island, which he appears to have thoroughly investigated. The results of his labours were afterwards given to the world in "The Naturalist in Vancouver Island." Mr. Lord afterwards served on the North American Boundary Commission, and later on was engaged by the Viceroy of Egypt to report upon certain characteristics of that country. It was from Egypt, we believe, that he was called by the directors of the Aquarium to take the appointment for which he was so peculiarly fitted.

THE University of Cambridge has passed a resolution by which in future successful candidates in Moral Science can present themselves for the next Natural Science Tripos, and *vice versâ*.

AN examination for minor scholarships for students intending to commence residence at Cambridge next October will be held at Clare College on Wednesday, March 25, 1873. One of these of the value of 50*l.* tenable for 3½ years, will be awarded for Natural Sciences. The subjects are Chemistry, Chemical Physics (including Light, Heat, and Electricity), Comparative Anatomy and Physiology, and Geology. Excellence in any two of these subjects will be preferred to a less perfect acquaintance with a greater number.

THE Janssen-Lockyer medal was presented by the French Government to the Academy at its sitting on Monday last week. May we hope that some time our Government may have attained to that degree of civilisation at which it will be possible for it to take official cognizance of additions to our scientific knowledge?

ON Saturday last, Prof. Huxley and the Marquis of Huntly were formally nominated for the Lord Rectorship of Aberdeen University. The election takes place on Saturday next.

AT a meeting of the faculty of the College of William and Mary, Williamsburg, Virginia, held on the 4th November last, it was unanimously resolved that the degree of Doctor of Laws be conferred upon Robert Potts, M.A. of Trinity College, Cambridge, England, in recognition of his successful labours as an educator and his valuable contributions to geometrical science.

THE Ricardo Scholarship in Political Economy has been awarded by Professors Cairnes and Courtney to Mr. Sereill. They also report that Miss Eliza Orme obtained a sufficient number of marks to qualify her for the scholarship had she not had so powerful a competitor.

DR. C. MEYMOTT TIDY, Professor of Chemistry at the London Hospital, has been elected Medical Officer of Health for Islington.

WE have received the Prospectus of the Royal Institution, and are glad to see that, in its new form, it places first among the chief objects for which it is established the promotion of scientific and literary research, and the teaching of the principles of inductive and experimental science. It informs the public of some of the great results which have followed from the experiments and original investigations which have been made in its laboratories by such men as Davy, Faraday, Tyndall, and Frankland. The chemical and physical laboratories have been this year rebuilt, and the liberal and permanent endowment of the professorships is now the chief thing wanting to ensure the promotion of scientific research. We hope this want may be short-lived.

THE Christmas lectures at the Royal Institution, intended especially for a juvenile auditory, will be by Prof. Odling, on Air and Gas. They will be six in number, and will be delivered on Dec 28 and 31, and Jan. 2, 4, 7, and 9, 1873.

AT the meeting of the National Academy of Science held at Cambridge, Mass., Nov. 22, Prof. Agassiz gave a very interesting account of his researches in the *Hassler* expedition, and especially of his discovery of the great South American glacier. He defended his rejection of the Darwinian theory of evolution on the ground that "his opponents are presenting views on scientific principles which are not even based on real observation; that they have not shown evolution, or the power of evolution, in the present day, and hence are not entitled to assume it in the past." He further characterised the theory as "a mire of mere assertion."

AN interesting event in the history of American science took place on Oct. 30, in Philadelphia, on the occasion of laying the corner-stone of the new building of the Philadelphia Academy of Natural Sciences. This institution was founded in 1812, and has for many years occupied the foremost rank among natural history establishments in America. The Academy since its establishment has been the recipient of many benefactions. Among those who have been most conspicuous in this connection may be mentioned William M'Clure and Thomas B. Wilson. To the latter gentleman is due very much of the present extent of its library and museum. The expense of the new building, it is pexected, will amount to $500,000, and it is hoped that sufficient funds will be contributed by the liberal-minded citizens of Philadelphia to complete the entire structure in a comparatively short space of time. The present building has long been inadequate to the accommodation of the collections of the Academy. According to statements made on the occasion referred to, the Academy now possesses more than 6,000 minerals, 700 rocks, 65,000 fossils, 70,000 species of plants, 1,000 species of zoophytes, 2,000 species of crustaceans, 500 species of myriapods and arachnidians, 25,000 species of insects, 20,000 species of shell-bearing molluscs, 2,000 species of fishes, 800 species of reptiles, 21,000 birds, with the nests of 200 and the eggs of 1,500 species, 1,000 mammals, and nearly 900 skeletons and pieces of osteology. Most of the species are are presented by four or five specimens, so that, including the archæological and ethnological cabinets, space is required now for the arrangement of not less than 400,000 objects, as well as for the accommodation of a library of more than 22,500 volumes.

WE are glad to see that the French Government, in its present trying circumstances, is not neglecting the interests of Science. By a decree of Nov. 25 last an Astronomical Commission has been charged with the preparation of a scheme for the organisation of the French observatories. The members of the commission are MM. Belgrand, Faye, Fizeau, Guillot, Janssen, Lespiaut, Le Verrier, Löwy, Puiseux, Rayet, Roche, Charles Sainte-Claire Deville, Stéphan, Wolf, Yvon-Villarceau.

MR. G. DEVYLDER writes from Ghent to the *Photographic News* in reference to the appointment by the Prussian Government of Dr. Vogel as Professor of Photography at Berlin, which we noticed last week, that Dr. Vogel's appointment is not the first in this department. Mr. Devylder has been Professor "official" of Photography at "L'Ecole Industrielle" of Ghent for more than ten years.

THE session of the Royal Society of Edinburgh was opened on December 2, by an address from the President, Sir Robert Christison, consisting mainly of the sketches of the lives of members of the Society who have died during the year. The Brisbane prize has been awarded by the council to Prof. Allman.

WE learn from the *British Medical Journal* that the chair of Practice of Medicine, in the Royal College of Surgeons, Ireland, vacant by the resignation of Dr. Benson, has just been filled by the election of Dr. James Little, the editor of the *Dublin Journal of Medical Science*. The election for the Professorship of Surgery, in the room of Dr. William Hargrave, will take place on the 24th of this month; Mr. Croly and Mr. Stokes are the only candidates at present in the field. It is no yet known who will be likely to be Mr. Hargrave's successor as representative of the College of Surgeons on the General Medical Council.

THE Paris correspondent of the same journal writes that the medical courses there are now open, and that three or four ladies are attending the *cliniques*:—"they are modest, well-informed, and intelligent ladies, and are much respected and kindly received by the professors; and our students, turbulent as they are, know how to respect those who come among them as strangers appealing to their gentlemanly souls, and show a better example than your riotous students of Edinburgh."

A MEDICAL Society for the West Riding of Yorkshire has been organised at Leeds, with Dr. Chadwick as president. Its object is to promote the study of Medicine and Surgery among Practitioners by the communication of clinical and therapeutical facts, and by the application of pathological specimens, and discussions thereon.

NUMEROUSLY attended meetings have been held at Totnes, Newton, Dartmouth, and Yeovil, for the purpose of establishing science and art classes for the instruction of young men.

The *Gardener's Chronicle* states that the Jardin d'Acclimatation has sprung into new life since the war, and has become the most fashionable resort in Paris. An additional feature of attraction is now being added to the rest—a large collection of rare shrubs recently brought from Algeria by M. Geoffroy, being in the course of arrangement in the great conservatory. In addition to this, it may be mentioned that two reading rooms are being arranged for the use of the members of the society and the public. One of these rooms is to be supplied with newspapers and literary and scientific publications, while the other is to be devoted to study, and to contain a complete scientific library.

Mr. H. C. Watson has printed, for private distribution, a Supplement to the Compendium of "Cybele Britannica," comprising an extremely useful epitome, accompanied by a map, of the distribution of all British species and sub-species of plants through the thirty-eight sub-provinces into which Great Britain is divided. We doubt the wisdom or the advantage to science of the introduction into a book, even if only printed for private distribution, of the personal matters which disfigure the Appendix to the volume.

We have received the 8th, 9th, and 10th parts of the new edition of Griffith and Henfrey's Micrographic Dictionary, bringing down the issue of this useful publication as far as Equisetaceæ.

Dr. William Ulrich publishes an International Dictionary of Plants in Latin, German, English, and French. Notwithstanding a few defects or inaccuracies in the English department, not to be wondered at in a work published in Germany, it appears to be, on the whole, extremely well done, and to be a very useful compilation. What we do not so often find in German books, there is an admirable and copious index.

Mr. James F. Robinson, of Frodsham, Cheshire, is about to publish "A Flora of the Isle of Man," in memory of Prof. E. Forbes, who was a native of the island. It will be illustrated with engravings of the principal island scenery (waterfalls, &c.). and accompanied with a specimen of the Manx fern (*Adiantum capillus veneris*) mounted as a vignette.

Mr. Buller, to meet the wishes of many of the most influential subscribers to his "Birds of New Zealand," intends to publish a series of supplementary plates, so as to include figures of all the species of birds inhabiting that interesting country. This will be a great gain to students of ornithology, who would otherwise have been left to search for representations of many of the most remarkable forms in works which are especially difficult of access—for instance the "Atlas" to the voyage of the *Astrolabe*, the bird-volume of the "Voyage of the *Erebus* and *Terror*," or Mr. Gould's magnificent but somewhat expensive "Birds of Australia."

A German correspondent inquires the name and price of the best and most complete work in English on the histology of hair and wool.

Ocean Highways, a journal excellently conducted, has an article in the December number on the Congo, by Lieut. Grandy, the leader of the "Livingstone Congo Expedition." He traces the history of discovery from 400 A.D., and says that no serious attempt has been made to explore the river since Capt. Tuckey's expedition of 1816.

On Friday, December 6, there was held, in the Corporation Galleries of Glasgow, under the auspices of the energetic Geological Society of that city, the finest geological exhibition that has ever been held in Scotland; indeed, according to the *Scotsman's* report, it has probably never been equalled elsewhere in Britain. In connection with the exhibition, there was also held a very successful *conversazione*. This Society, which is one of the most efficient in the country, was formed in May 1858. The unusually rich and varied collections exhibited all belonged to private individuals, but would have done credit to any high-class public museum. Glasgow, the commercial capital of Scotland, if it hold out as it has been doing recently, may ere long vie with "the grey metropolis of the north" as a centre of the highest culture.

In the *Arnhemsche Courant* of December 4, H. van de Studt has an article on the intimate connection between the recent meteoric shower and Biela's comet.

The Continental scientific journals have the same brilliant tale to tell of the meteoric display of the night of Nov. 27-28 last as we had. From all parts of France and from various parts of Italy observers speak of "the rain of falling stars" which was kept up for several hours, and all agree that the radiant point was in the constellation Perseus, near to Cassiopeia. Father Secchi says that at Rome, between 7.30 P.M. and 1.30 A.M., 13,892 were counted; while *L'Institut* says that the average in most places was two meteors per second, while in some places the number registered amounts to upwards of 40,000. M. F. Raillard, writing to *Les Mondes*, says that so long ago as January 1839, he communicated in a note to the Academy the idea that shooting stars, the aurora borealis, and comets, had a common origin.

In reference to the extraordinary whirlwind in Ireland, of which we lately printed an account, the following note has been communicated to us from Mr. C. J. Webb, of Knockvarre, Randalstown:—"I have received no further definite information respecting the course taken by the whirlwind except that contained in my letter. I think it probable, however, that it crossed to Scotland, forming itself into a waterspout while passing over the sea, as, a few days afterwards, I saw an account in the daily paper of a most destructive waterspout, which broke some time on the night of the same Sunday that the whirlwind visited us above the coach road near Lough Katrine, rendering it impassable for several days, owing to the trees, *débris*, &c., which were swept down by the flood."

Another phenomenon of a similar kind is recorded as follows by a correspondent of the *Birmingham Morning News*. The people living near King's Sutton, Banbury, say that about one o'clock on Saturday they saw something like a haycock revolving through the air, accompanied by fire and dense smoke. It made a noise resembling that of a railway train, but very much louder, and travelled with greater rapidity. It was sometimes high in the air, and sometimes near the ground. It passed over the estate of Colonel North, M.P., Sir W. R. Brown, Bart., and Mr. Leslie Melville-Cartwright, whose park wall it threw down to the foundation in several places, and at one place for upwards of sixty yards. A man named Adams was breaking stones, and a minute before he was standing under a tree that was torn up by the roots and the branches scattered in every direction. Two or three trees near him were torn up, and one of them, the largest beech on Sir William Brown's estate, which tore up with it twelve or fifteen tons of earth. For a distance of nearly two miles, hedges, rails, trees, hovels, and ricks have been knocked down or injured. A whirlwind followed the fire-meteor, and carried everything before it. Stones from the walls knocked down were carried forty yards away, and the water in a pond disappeared on the passage of the phenomenon. After travelling about two miles the meteor seemed to expend itself, and disappeared all at once. There was a heavy fall of rain at the time, and a vivid flash of lightning just before. The direction taken by the meteor was from south to north, and it travelled almost in a straight line.

MIMICRY IN THE COLOURS OF INSECTS*

Having observed that in treating of the interesting phenomena of mimicry, writers have used indiscriminately very different factors, I shall try to give some preliminary ideas which I do not find published, and which I believe will be useful in explaining this interesting subject.

It will be best to consider the colour and pattern separately. There are three different kinds of colours: viz., colours produced by interference of light, colours of the epidermis, and colours of the hypodermis. All three may either be wanting, or all three or two of them may occur together in the same place.

Colours produced by interference are produced in two different ways: first by thin superposed lamellæ, as in the wings of Diptera, Neuroptera, &c., without any other colour, as in hyaline wings, or connected with other colours as in the scales of Entimus and others.

There must be at least two superposed lamellæ to bring out colours by interference, and there cannot be more than four, as both wings and scales consist only of four layers, two internal belonging to the hypodermis, two external belonging to the epidermis. In fact, if scales taken from dry specimens of Entimus are observed under the microscope, many partly injured can be found, which give different colours according to the layers of the lamellæ which remain.

Secondly, colours by interference are produced by many very fine lines or striæ in very near juxtaposition, as in Apatura and other colour-changing insects. Colours by interference may perhaps be sometimes also produced in the same way as in the feathers of the dove's neck by very small impressions situated near together.

The colours produced by the interference of light are only optical phenomena, differing in this respect from the other colours of the body, the epidermal and hypodermal colours.

The epidermal colours belong to the pigment deposited in the cells of the chitinised external skin, the epidermis. These colours are mostly metallic blue, green, bronze, golden, silver, black, brown, and perhaps more rarely red. The epidermal colours are very easily recognised, because they are persistent, never becoming obliterated or changed after death.

The hypodermal colours are situated in the non-chitinised and soft layer, called hypodermis by Weismann. They are mostly brighter and lighter, light blue or green, yellow, milk white, orange, and all the shades between. The hypodermal colours *in the body* of the insect fade or change, or are obliterated after the death of the insect. A fresh or living insect when opened may easily be deprived of the hypodermal colours simply by the action of a little brush. I said hypodermal colours in the body, because there are hypodermal colours which are better protected, being encased nearly air-tight, and therefore are more easily preserved even after the death of the insect. I refer to the colours in the elytra and wings, and in their appendages, the scales. The elytra and the wings are, as is well known, at first open sacs in communication with the body, of which they are only the extension; of course they are formed of the epidermis and hypodermis, which become so strongly glued together after the transformation into the imago state that a maceration of years tried by me showed no effect at all on such wings. This fact is very interesting, as it explains how wings, and even coloured wings, can be found in palæontological layers in good preservation. The destruction of insects, which is so peculiar to the secondary strata in England, proves, as I believe, that the bodies of the insects must have floated a very long time before they were deposited. It is quite a rarity to find well-preserved insects there, although many well-preserved wings, even of lace-winged flies, have been described.

There is an interval after the transformation, before the membranes of the wings become inseparably glued together; it is at this time that the finishing of the colours takes place. For instance in an Æschna, a *Libellula depressa* or *trimaculata*, if the wing is cut off at the base, the two layers can be easily separated by manipulation under water, and the wing can be inflated with a little tube by separating the borders with a knife. I can show specimens so prepared. But this is only possible as long as the wings possess the appearance of having been dipped into mucilage, an appearance which is well known in young Odonata.

The scales have just the same development as the wings. At first they are little open sacs, communicating with the hollow of the wing and the whole body, and at a later period are glued together like the wings themselves.

In the wings and in the scales the hypodermal colours are formed and finished before the wings stick together, and by this means they are well preserved and safely encased. They have no more communication in the glued parts with the interior of the animal, and are preserved in the same way, as if hermetically inclosed in a glass tube. There are even here in the wings and scales many epidermal colours, chiefly the metallic ones; but all the brighter colours (for instance the somewhat transparent spots in the elytra of the Lampyridæ, Cicindelidæ, &c., and in the greater number of Lepidoptera) are, as I believe, hypodermal colours.

Finally there sometimes occurs outside of the animal, that is, on the epidermis, a kind of colour which I consider as hypodermal colour, such as the pale blue on the abdomen of many Odonata, the white on the outside of many Hemiptera, the pale grey on elytra and thorax of the Goliathus beetle, the powder on Lixus and others. Some of these colours are very easily resolved in ether, and are apparently a kind of wax. I believe that these colours are produced by the hypodermis, and are exuded through the little channels of the pores.

The hypodermal colours are very often different in males and females of the same species, the epidermal colours rarely differ so far as I know; but there are genera with prominent epidermal colours which are nearly always different in different sexes, viz., Calopteryx, Lestes, some Hymenoptera, &c.

It would be interesting to know the different colours of the epidermis in such cases. So far as I know, the change seems to be between related, and not between complementary colours. But my observations are far from having any conclusive importance. The same investigation would be necessary for the hypodermal colours.

The hypodermal colours may change or be altered in some male or female during its lifetime, by sexual or other influences. The epidermal colours never change. By sexual influences yellow is changed into orange, brown into red, and even sometimes more changed. By other influences, for instance by cold in hibernation, pale yellow is changed into red (Chrysopa). The hypodermal colours may be changed even by a voluntary act of the animal, and the new colours disappear again (Cassida). The hypodermal colours are the only ones on which the animal has any influence, either involuntarily by the action of the nutritive fluid, or voluntarily. The epidermal cells are placed entirely outside of any influences of the animal, when once established. It will perhaps be possible to prove that the so-called mimetic colours are all hypodermal colours.

The hypodermal colours seem to be produced by a photographic process (I know no better expression), the epidermal colours by a chemical process of combustion or oxidation. Would it be possible to prove that by a photographic process even the colours of the surrounding world could be transmitted, a great step towards an understanding of the phenomena would be gained. The fact, of course, is very probable, at least, in some instances.

In observing the mimicry, the pattern of an insect must be clearly separated from the colour. In fact, the pattern is not the product of an accidental circumstance, but apparently the product of a certain law, or rather the consequence of certain actions or events in the interior of the animal and in its development. The proof is very easily afforded by the regularity of the pattern in a genus or a family of insects. If studied carefully and comparatively, the pattern in a genus is the same, or is only more or less elaborated. The number of such families is so exceeding great that some example will readily occur to every one.

Moreover a certain and constant pattern can be found for the head, a different pattern for the segments of the thorax, and a different pattern for the segments of the abdomen. This pattern is in the different segments of the abdomen (Hymenoptera, Diptera, Neuroptera, Orthoptera) always the same, only more or less elaborated, and less finished in the first and last segments. In some way the same is true for the thoracic segments.

In some few instances I was able to observe how the pattern is produced. In the Odonata (Dragon-flies) at the moment of transformation the thorax is transparent, and shows no colours at all. At this time the muscles are without importance, and in process of formation. The thoracic muscles, as is well known, are, in the Odonata, very powerful, and also very extraordinary as regards the shape of their tendons. Just along outside the muscles are dark lines more or less well finished, and resulting from the action of the muscles. *Ubi irritatio ibi affluxus.* I believe that it would not be unphilosophical to conclude that a powerful action in the development of the muscles is, in such a case, the cause of a greater combustion or oxidation in the neighbouring parts. In fact, on the head of a Cicada and on the abdomen of an Æschna we find similar patterns, in some way mostly representing the underlying muscles. In the Gomphina the fact is striking, and far more as the stronger species mostly possess a large dark pattern. There are some very small species which are almost entirely yellow; there are no small species entirely black.

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* Reprinted from the *American Naturalist* for July 1872.

Should the fact, with the explanation, be admitted, a step farther in the explanation of the different patterns would be made. I know very well that in the Odonata there are patterns which do not agree with my explanations, even some contrary to it; but if some certain facts be explained, there are perhaps more factors still unknown or unobserved. The explanation for certain facts would still be admissible, or at least not entirely objectionable.*

The patterns on the wings and elytra could not be the product of the action of muscles, but I believe it to be probable that the sudden rush of blood, or even air, by the accelerated circulation and respiration in the act of transformation may have the same effect. In this way some patterns, otherwise not explicable, could be understood. The eyespots in the caterpillars of some Papilionidæ have been ascertained by Leydig to be epidermal colours, and I believe that the various kinds of eyespots in the wings of the imago are also epidermal colours. If a stream of blood meets a small obstacle just in the centre, a funnel is formed; if this obstacle is a ring, and behind it another obstacle, we have two or more funnels, one in the other, and the section of them will be circular or elliptical according to the angle at which they reach the surfaces. Such patterns in the elytra and wings are formed or preformed at the time when the wing is a sac; sometimes before the transformation, and here is another circumstance which explains some patterns. The walls of the sac are suddenly augmented and strongly dilated in the transformation. Small patterns performed in the sac will also be altered and enlarged by the same process, and I know that many patterns of Lepidopterous wings are in such a way very easily explained All the waved lines of the wings and other marks belong here, and as the ribs or nervures seem to grow faster in transformation, the waved appearance would be explained In fact the greater part of the patterns seem to be produced by expansions or distraction of the pattern performed in the wing at some period before the transformation. H. HAGEN

SCIENTIFIC SERIALS

THE *Monthly Microscopical Journal* for October 1872, contains a continuation of Dr. Robert Braithwaite's papers on bog mosses, the present communication being confined to *Sphagnum neglectum* Angstr. Dr. J. J. Woodward contributes a reply to further remarks on Tolles' $\frac{1}{8}$th and Powell and Lealand's $\frac{1}{16}$th. This is succeeded by a communication "On the History, Histological Structure, and Affinities of *Nematophycus Logani* Curr. (*Prototaxites Logani* Dawson), an Alga of Devonian Age," by Wm. Carruthers, F.R.S., in which the author combats the theory advanced by Dr. Dawson, that the fossil in question is coniferous, and contends that it is cryptogamous, belonging to a gigantic alga, of the class *Chlorospermeæ*. Two plates accompany this very interesting and important communication.—"On the active part of the Nerve Fibre, and on the probable nature of the Nerve Current," by Lionel S. Beale, F.R.S., is a further contribution to the researches for which Dr. Lionel Beale has earned a reputation.—"On the Regeneration Hypothesis," by Dr. Louis Elsberg, of New York. The fundamental proposition of this hypothesis is thus stated by its author: "The germ of every derivative living being contains plastitudes of its whole ancestry."—Dr. J. J. Woodward contributes some observations on the use of monochromatic sunlight, as an aid to high-power definition.—A short paper by Prof. Albert H. Tuttle, on one of our common monads is from a communication made to the microscopical section of the Boston Society of Natural History.

Bulletin de l'Académie Royale de Belgique, No. 8. This number contains a mathematical paper of some length, by M. P. Mansion, on singular solutions of differential equations of the first order; also a note by M. Dubois describing some researches on the camphors. He studied the action of pentasulphuret of phosphorus at a high temperature on monobromated camphor, and found that it gave cymol, accompanied with small quantities of hydrocarbons of the same homologous series, and an organic sulphhydrate soluble in alkalies. M. Alphonse Waters gives a sketch of some efforts that were made in Belgium in the middle of the 17th century towards the establishment of free trade.—A note by M. Schuermanns treats of the discovery of objects of amber in Belgium, the writer advising a special study of the circumstances which may have connected Belgium with the commercial route from Etruria to the country of amber, on the Baltic.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 5.—"Colouring-matters derived from Aromatic Azodiamines." II. Safranine. By Drs. A. W. Hofmann, F.R.S., and A. Geyger.

Whilst we were engaged with the study of the blue colouring-matters produced by the action of aromatic monamines on azodiphenyldiamine, our attention became directed to a beautiful red tar-pigment, which has been known for some time by the commercial name of Safranine, being extensively used as a substitute for safflower in dyeing silk and cotton. Safranine has not as yet been minutely examined; but, as far as can be judged from the scanty information we possess regarding its production, it is scarcely doubtful whether this important dye must be looked upon as being the derivative of an azodiamine. The analyses of safranine thus promised to throw considerable light upon the nature of the compounds under examination.

Saframine occurs in commerce either as a solid body or *en pâte*. In the solid state it forms a yellowish-red powder, in which, together with considerable quantities of chalk and common salt, the chlorhydrate of a tinctorial base has been recognised. The pure dye may be easily separated from the crude safranine. It is only necessary to exhaust the commercial product with boiling water; on cooling, the filtrate deposits a slightly crystalline substance, which, after several recrystallisations from boiling water, leaves no residue on ignition. During these operations, however, the salt undergoes perceptible alteration; with every recrystallisation it becomes more soluble and less crystalline. These alterations depend upon the separation of chlorhydric acid from the salt. In fact the percentage of chlorine is found to diminish in the product of successive crystallisations; thus the product of the third contained 8·48 per cent. that of the fourth crystallisation only 7·46 per cent. Addition of chlorhydric acid to the mother-liquors at once reproduces a crystalline precipitate. This instability of the chlorhydrate, and, in fact, as may even now be stated, of the salts of safranine in general, has very considerably impeded the study of this body, and often materially affected the accuracy of the analytical results. In order to obtain the normal salt, the boiling liquid during the last crystallisation had always to be acidified with chlorhydric acid.

"Synthesis of Aromatic Monamines by Intramolecular Atomic Interchange." By Dr. A. W. Hofmann, F.R.S.

In a paper submitted to the German Chemical Society about a year ago, we proved (Dr. Martius and myself) that the action of methylic alcohol on aniline chlorhydrate at a high temperature and under pressure, far from yielding exclusively methyl- and dimethylamiline, as has been formerly believed, is capable of causing methylation of the phenyl group, and thus producing quite a series of higher homologues of dimethylaniline.

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* So far as I know the literature relating to the phenomena of mimicry, all these related differences are often confused, and I believe that in separating them and following the views above given, many facts would be better understood, and this interesting subject more easily advanced.

Besides all the difficulties which oppose a clear and correct view, there is one more which I do not find mentioned, *i.e.* the so-called colour-blindness, and the different degrees of it. Prof. B. A. Gould in his excellent work, "Investigations on Anthropological Statistics of American Soldiers," has given attention to it in a very remarkable chapter. Persons who cannot distinguish ripe cherries upon the tree, or strawberries on the vine by their colour, are far more numerous than would be suspected. Serious misunderstandings, and even calamities, have been reported in the army, resulting from mistakes in the colour of green and red light by officers of the signal corps. He gives the statement that usually one in twenty, and in the soldiers examined one in fifty, was subjected to colour-blindness. But these numbers show only the extremes; and it is easy to believe that a much greater number are more or less affected with it. In fact, we have no means of measuring this physiological difference; if two persons call something green, and even compare the colour with certain known objects, there is no proof at all that they see just the same colour. I think that it would be prudent in describing cases of mimicry, especially when they are extraordinary, not to forget that even the best observer may be unaware of this infirmity, and in fact the best authorities on colour-blindness always state that the greater number of persons have no idea of their infirmity.

If we endeavour to gain an insight into the mechanism of this reaction, we are led to assume that in the first instance the chlorhydric acid of the aniline salt gives rise to the formation of methylic chloride, which in its turn induces substitution, first in the ammonia fragment, and ultimately in the phenyl group itself. If, on the other hand, we remember that a tertiary monamine, such as must be formed by the final methylation of the ammonia fragment in aniline, when submitted to the action of an alcohol chloride, is invariably converted into an ammonium compound, it must appear rather strange that in the process above alluded to only tertiary, and never any quaternary bases are observed.

Under these circumstances the idea very naturally suggested itself of submitting the behaviour of quaternary compounds at a high temperature under pressure to an experimental investigation.

The simplest compound that could be detected for such an inquiry appeared to be trimethylphenylammonium iodide.

$$C_6H_5 . CH_3 . CH_3 . CH_3NI.$$

Reserving for a future communication the experimental details of this inquiry, I will limit myself for the present to a brief statement of the principal result obtained.

Leaving secondary reactions out of consideration, the transformation of the trimethylated phenylammonium iodide is represented by the following equations :—

Transformation of quaternary into tertiary compound.

$$C_6H_5 . CH_3 . CH_3 . CH_3 . NI = (C_6H_4 . CH_3)CH_3 . CH_3 N . HI.$$

Transformation of tertiary into secondary compound.

$$(C_6H_4 . CH_3) . CH_3 . CH_3 . N . HI = [C_6H_3(CH_2(CH_3)_2]CH_3 . HN . HI$$

Transformation of secondary into primary compound.

$$[C_6H_3(CH_3)_2]CH_3 . HN = [C_6H_2(CH_3)_3]HHN . HI.$$

Accordingly trimethylated phenylammonium iodide, when submitted to the action of heat, is transformed in the first place into iodhydrate of dimethylated methylophenylamine or dimethyl toluidine; this, in a second phase of the reaction, becomes iodyhdrate of monomethylated dimethylophenylamine, or xylidine, which in its turn is ultimately converted into iodhydrate of trimethylophenylamine, *i.e.* of cumidine. The essential character of the reaction is thus seen to be an intramolecular change in the position of the methyl groups. According to the duration of the process, there are incorporated in the benzol nucleus, first the methyl group of the alcohol iodide, and then successively the two methylic groups which are stationed in the ammonia fragments. The action of heat on the quaternary ammonium compound thus places at our disposal a simple means of rising from the benzol series itself to the toluol-, xylol-, and cumol series, or, generally (for the reaction may probably be utilised in many other cases), of passing from a less carbonated to a more carbonated series of compounds.

"New Method for producing Amides and Nitriles." By E. A. Letts, Berlin University Laboratory.

"Investigation of the Attraction of a Galvanic Coil on a small Magnetic Mass." By James Stuart.

Geological Society, Nov. 20.—Prof. P. Martin Duncan, F.R.S. vice-president, in the chair.—"On the Geology of the Thunder Bay and Shabendowan Mining Districts on the North Shore of Lake Superior." By H. Alleyne Nicholson, M.D. The author described the general characters of Thunder Bay, which is almost landlocked on the south-east by the bold promontory of Thunder Cape and a series of islands which form a continuation of this. The rocks immediately surrounding Thunder Bay belong to the "Lower and Upper Copper-bearing series" of Canadian geologists. The author described the general characters of Lake Shabendowan, and stated that from the foot of the lake for about 15 miles westward there is a succession of trappean rocks, beyond which, to the head of the lake, distant 13 miles, the country is occupied by Huronian slates like those between the lake and Thunder Bay. These slates extend for an unknown distance north-west of the head of the lake, and contain numerous veins, having an E.N.E. and W.S.W. direction, conformable with the strike of the beds, and some of them are auriferous. The vein-stuff is quartz containing copper pyrites; the gold is contained in the copper pyrites, or disseminated in very minute grains through the quartz. Several of these veins are being worked, and their peculiarities were noticed by the author.—"Note on the Relations of the supposed Carboniferous Plantants of Bear Island with the Palæozoic Flora of North America," by J. W. Dawson, LL.D., F.R.S. The author referred to Dr. Heer's paper on the carboniferous flora of Bear Island (see Q. J. G. S. vol. xxviii. p. 161), and stated that the plants cited by Dr. Heer as characteristic of his "Ursa Stage," are in part representatives of the American flora belonging to what the author has called the "Lower Carboniferous Coal-measures" (subcarboniferous of Dana). He considered that the presence of Devonian forms was due either to the mixture of fossils from two distinct but contiguous beds, or to the fact that in these high northern latitudes there was an actual intermixture of the two floras. He dissented altogether from Dr. Heer's identification of these plants with those of the Chemung group, or with those of the Middle Devonian of New Brunswick. Mr. Carruthers stated that the list of the eleven Lower carboniferous plants published in Principal Dawson's "Acadian Geology" did not contain a single species found in Bear Island; but, on the other hand, some species and several well-marked forms were common to the Bear Island deposits and the Devonians of North America, and he had no doubt that Prof. Heer had in his paper rightly correlated these floras. As to the age of these plant-bearing beds, found alike in Bear Island, Ireland, the Vosges Mountains, Canada, and Australia, Mr. Carruthers said that it was difficult to draw any lines which would separate the Palæozoic plants into clearly-marked and distinct floras; but if the Devonian is to be retained as a system, all these plant-bearing beds belonged rather to that system than to the carboniferous.—"Further Notes on Eocene Crustacea from Portsmouth." By Henry Woodward. In this paper, after referring to his former communication on Crustacea from the Lower Eocene deposits at Portsmouth (Q.J.G.S., vol. xxviii. p. 90), the author gave a full description of *Rhachiosoma bispinosa*, one of the new species described in it, the materials being furnished by several fresh specimens, which show the whole structure of the animal. The new points include the description of the limbs, the anterior border of the carapace, the lower surface of the body in both sexes, and the maxillipeds. The author also characterised, under the name of *Litoricola*, a new genus of shore-crabs allied to *Grapsus*, from the same deposits. Of this genus he described two new species, *L. glabra* and *L. dentata*.—"On a new Trilobite from the Cape of Good Hope." By Henry Woodward. The Trilobite described in this paper is from the Cock's Comb Mountains at the Cape of Good Hope, and was preserved in a nodule, the impression retained in which, when broken, furnished the most instructive details as to its structure. Each of the eleven thoracic segments was furnished with a long median dorsal spine, giving to the profile of the animal a crested appearance; on each side of this the axis of the segment bears two or three tubercles, and the ridge of the pleura four or five tubercles. The tail is terminated by a spine more than half an inch in length, and all the spines are annulated. For this Trilobite the author proposed the name of *Encrinurus crista-galli*, although with some doubt as to the genus, the head being only imperfectly preserved.

PARIS

Academy of Sciences, Dec. 2.—M. Faye, president, in the chair.—The first paper was by M. de Saint-Venant on the division of the force due to a vibratory movement into those due to simple and isochronous oscillations, &c., and of the work due to the same composite movements, at any two moments, between the constituent movements.—M. Claude Bernard read a note in answer to M. Bouillaud's paper on animal heat. He states that the latter author, in asserting that the arterial blood in the heart is warmer than the venous, has disregarded numberless experiments which prove the direct contrary to be the case. To this M. Bouillaud replied, defending the theory of the heat of the body actually being formed in the lungs by the combustion in them of carbon compounds in the blood, this being Lavoisier's original theory, which he defends.—A letter from Father Secchi on the meteors of Nov. 27 was then read; from 7.30 P.M. to 1 A.M. 13,892 meteors were observed.—MM. Is. Pierre and Ed. Puchot read a paper on certain observations on the laws deduced from the boiling points of the members of homologous series. The authors find that the rise in boiling point for each addition of CH_2 is not so regular as is supposed.—M. A. Caligny read a paper on the "Theory of the Sluice of L'Aubois," a paper relating to canal works, and M. Thém Lestiboudois one on the structure of heterogenic vegetables. The section of the paper read related to heterogeneous monopetalæ. After this M. Dupuy de Lôme read a note on the preservation of the material of a "screw balloon."—A report on M. Felix Lucas's memoir on the general theorems of the equilibrium and movements of material systems was then read, and followed by a note by M. Marès on the utility of a permanent scientific institution in Algeria. M. H. Resal read a note on the relation between the pressure and the volume of steam which expands in producing work without the addition or subtraction of heat.—MM. E. Mathieu and D. Urbain read a paper on the part played by gases in the coagulation of milk and in producing muscular rigidity. The authors believe these effects to be due to oxidation.—Anatomical researches on limules, a note by M. Alph. Milne-Edwards, was next read, and followed by a description of a new method of treating intermittent fevers, by M. Déclat. A feature in this treatment is the administration of small doses of carbolic acid.—Communications on the *Phylloxera* from M. A. Laliman and M. A. Vidal were sent to the commission on *Phylloxera;* a note on the tertiary formations of Lormandieres, by M. Delage, was referred to a special committee; and notes on aerostation from MM. Billet, Braconnier, Deppe, and Chamard were sent to that commission.—A copy of the Janssen-Lockyer Medal was sent by the Minister of Public Instruction.—M. A. Laussedat then read a note on the prolongation of the French meridian into Spain and Algeria.—M. Mannheim described a model of a vernier to a vernier, and M. Gramme read a note on the application of his magneto-electric machines to electrotype and the production of light. He asserts that his machine produces greater effects than Wilde's well-known instrument, though driven at one-eighth of the speed.—M. Becquerel presented a note by M. E. Jannettaz, continuing his observations on the connection between cleavage planes, cohesion axes, and axes of thermic conduction in crystals.—M. Th. du Moncel presented the continuation of his paper on the currents produced in a telegraphic wire, one end of which rests insulated in the air.—M. A. Treve read a note on Magnetism, in which he describes some experiments on magnetic induction.—M. Balard presented a note on a new brominated ether, by M. P. Schützenberger. The formula of the new body is stated to be $(C_4 H_{10} O Br._3) 2$. It is crystalline, very deliquescent, and heated to 70° to 80° disengages hydrobromic acid in large quantities and decomposes. M. Malhe described the manufacture of a neutral soap by exposing ordinary soap to carbonic anhydride.—MM. Rabuteau and Papillon read a note on the Therapeutic effects of Sodic Silicate. They believe that it is likely to be of great use in certain skin diseases. M. Picot's second note on the "Antifermentescible" properties of the same salt followed; he has used it with great success in cases of blenorrhagia.—M. A. Bechamp then read a note on certain of M. Pasteur's recent communications on ferments, a long contribution to the controversy, which has now nearly worn itself out, and followed it up with a joint communication of his own and M. Estor on M. Pasteur's paper of the 7th of October. M. P. Champion read a note on a substance extracted from a Chinese Champignon. The fungus is that known to the Chinese as Fouh-ling (*Pachyma pinctorum*). The author proposes to call the extract pachymose. It somewhat resembles starch, and its formula is $C_{20} H_{24} O_{28}$.—M. Claude Bernard presented a paper on the number of the Blood Corpuscles in Mammalia, Birds, and Fish, by M. Malassez. The author calculates that in the mammalia the number varies from 3,500,000 per cubic millimeter to 18,000,000; in man it is about 4,000,000. In birds the number is much less, from 1,600,000 to 4,000,000. In fish the osseous fishes have 700,000 to 2,000,000; the cartillaginous, 140,000 to 230,000. M. Larrey presented M. G. Le Bon's paper on some experimental researches on the Treatment of Asphyxia; which was followed by a note by M. L. Vaillant on the value of certain characters used in the Classification of Fish; and by a note on the larval form of the dragon-flies, by M. A. Villot.—A note by M. F. Pisani on a new vanadiferous-silicoaluminate of manganese from Salm Chateau, Belgium, was then read. The mineral contains 1·8 per cent. of vanadic acid, and in composition resembles masonite.—M. Daubree presented a paper on the superior Jurassic formations of the department of L'Herault, by M. Bleicher.—M. Stan. Meunier read a paper on the lithological analysis of the meteorite of the Sierra de Chaco, Chili; and on the mode of formation of logronite.—M. Le Verrier communicated a long list of observations of the meteoric shower of the 27th November from various observers.—A note on the same subject was received from M. Malinowski.—M. Champouillon communicated some experiments on the effects of borax and sodic silicate on malt; his results confirm those of M. Dumas. M. Sacc communicated a note on the colouring matter of the red carrot the colouring substance is insoluble in water, slightly so in alcohol, more so in ether. In the carrot it exists to the extent of not more than one part in 1,000.—M. Roenler described a method for reversing drawings for the engraver.—M. Prunières sent a note relative to the researches in lake Saint-Andéol (Lozère); he believes that the rest of the structures ascribed to man there found are those of beavers.—Mdlle. Chenu sent two notes on the "Functions of the Great Sympathetic" and on a method for the observation of the ganglionic nervous system, after the reception of which the session was adjourned.

BOOKS RECEIVED.

English.—A Manual of Palæontology: H. A. Nicholson (Blackwood and Sons).—The Ocean, Section I. and II.: E. Reclus (Chapman and Hall).—Elements of Chemistry, Part I., 5th edition: W. A. Miller (Longmans).—Zoological Mythology, vols. I. and II.: A. de Gubernatis (Trübner).

DIARY

THURSDAY, December 12.

Royal Society, at 8.30.—A Contribution to the Knowledge of Hæmoglobin: E. Ray Lankester—On the Structural Elements of Urinary Calcule: Dr. H. V. Carter.—Researches in Spectrum Analysis in connection with the Spectrum of the Sun. No. I.: J. N. Lockyer, F.R.S.

Society of Antiquaries, at 8.30.—On a Celtic Tumulus in Kent: C. Knight Watson, M.A.

London Mathematical Society, at 8.—On Geodesic Lines, especially those of a Quadric Surface; and on the Mechanical Description of certain Quartic Curves by a modified Oval Chuck: Prof. Cayley.—Note on the breaking up of the Inharmonic-ratio Sextic: J. J. Walker.—On a Deduction from Standt's Property of Bernoulli's Numbers: J. W. L. Glaisher.

FRIDAY, December 13.

Astronomical Society, at 8.

SUNDAY, December 15.

Sunday Lecture Society, at 4.—On the Ear, and how we hear: John S. Bristowe, M.D.

TUESDAY, December 17.

London Institution, at 4.—On Elementary Physiology: Prof. Rutherford.

Anthropological Institute, at 8.—Origin of Serpent Worship: C Staniland Wake.—The Garo Hill Tribes: Major Godwin-Austen—The Kojahs of Southern India: Major Godwin-Austen.—Primordial Inhabitants of Brazil: Capt. Burton and M. H. Gerber.

WEDNESDAY, December 18.

Society of Arts, at 8.—On Russia, her Industries, Commerce, and Means of Communication: Prof. Leone Levi.

Geological Society at 8.—Further Notes on the Punfield Section: C. J. A. Meyer.—On the Origin of Clay-Ironstone: J. Lucas.—On the Coprolites of the Upper Greensand Formation, and on Flints: W. Johnson Sollas, St. John's Coll. Camb.

Royal Society of Literature, at 8.30.

THURSDAY, December 19.

Royal Society, at 8.30.

Linnean Society, at 8.—On the General Principles of Plant-construction: Dr. M. T. Masters, F.R.S.

Chemical Society, at 8.

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THURSDAY, DECEMBER 19, 1872

ARCTIC EXPLORATION

IT is now upwards of twenty-five years since the British Government sent out any expedition to those little known northern regions, the exploration of which has won so much glory to the British navy, formed such a splendid and peaceful sphere for the training of our sailors, and been so fruitful in the highest results to Science. Since that time, and especially during the last few years, every important civilised power in the world, except Britain, has been doing what it could to advance the interests of Science, which are coincident with the highest interests of humanity, by sending out expedition after expedition to force from the Arctic Regions the wonderful secrets which they have so long held in their icy grip. What has been done by other nations has been sufficiently detailed from time to time in these pages, and the knowledge thus gained cannot but be of the greatest service to any deliberately organised expedition which this country may send out.

About seven years ago the Geographical Society tried to move the Government to take action in the matter, and to fit out an Arctic expedition; but Government excused itself then on account of the want of agreement among geographers as to the most favourable route to be followed. Since then there has been much discussion on this point, and the results of recent expeditions have led to almost entire unanimity among those best able to judge as to the route which is most likely to be in every way attended with successful results. Therefore the distinguished deputation which on Monday waited upon the Chancellor of the Exchequer and Mr. Goschen was not one got up in hot haste as the result of some temporary excitement, but was the culmination of long discussion and deliberation founded on many years' accumulation of pertinent and valuable facts. The deputation was the bearer not merely of the desires and convictions of the distinguished scientific societies whom it represented. Arctic exploration has in this country ever been popular with all classes, and to judge from the earnest and enthusiastic tone in which most of our leading newspapers speak of the objects of the deputation, the public mind is as strongly set as ever on seeing that work completed which for so long has engaged theenergies of some of the greatest names on the roll of the British navy.

That the Government will forthwith respond favourably to the universal desire, when this has been so clearly, fully, ably, and unanimously brought before it by our most distinguished learned societies, we think there cannot be any doubt. What Government will do when reputable men of science come before it with a well-defined and important object has been shown in the expedition, so liberally fitted out, which has just left our shores on board H.M.S. *Challenger*. Indeed, we believe that Government would long ago have done something towards Arctic exploration had the matter been brought before it as powerfully and definitely as it was on Monday.

As was well urged by the deputation, without such an Arctic expedition as is wanted, the work which it is sought to accomplish by the *Challenger* must remain incomplete; the work set before that ship is of magnitude sufficient to engage it during all the time it will be abroad; and if Government is really in earnest in advancing the interests of science by marine exploration, it cannot choose but fit out an Arctic expedition as the indispensable complement to that which is about to explore the middle and southern latitudes of the globe. The answer that was given by the Chancellor was all that was asked, and all that we could expect; and it seems to us that if he and his colleagues do what he has promised—"carefully consider the matter, and read over the papers" laid before them—they can only form one opinion. We only hope that all sections of the Press—as the mouthpiece of all the various classes of the people—will say very unmistakeably what is the conclusion that all intelligent subjects of Her Majesty desire their purse-keeper, Mr. Lowe, and his colleagues to come to. If this and all other legitimate influences are used, and if Government treats the subject justly, and without prejudice, we have no doubt that by next May the resumption of Arctic exploration by this country will be a thing accomplished.

The deputation, headed by Sir Henry Rawlinson, represented the Royal Society, the Royal Geographical Society, the Geological Society, the Linnean Society, the Anthropological Institute, the Scottish Meteorological Society, and the Meteorological Office in London. Each of these bodies, in response to a letter from the Geographical Society, sent in papers showing the important objects to be gained from its own point of view, by a well-organised Arctic expedition. These papers, with the statements of the Geographical Society, maps, &c., were laid before the Government by Sir H. Rawlinson, and it is after the consideration of these that Mr. Lowe has promised to give his opinion. It is only needful here to state very briefly the points brought before Mr. Lowe and Mr. Goschen by the deputation.

Arctic authorities are now almost unanimous that the best route for an expedition to follow is up the west coast of Greenland to Baffin's Bay and Smith's Sound, one reason being that in this direction facilities are offered, in case of disaster, for retreat to the Danish settlements; besides, in this direction the most varied and most valuable scientific results may be obtained, and all seem agreed that this is the route along which the extreme north is most likely to be reached. The deputation thought that nothing better could be got in which to convey the expedition, than two strongly-built and thoroughly-strengthened Dundee screw-whalers of from 200 to 300 tons each, and each having a Government crew of 60 men and officers. These should start next May, and should be equipped and provisioned to carry on their work for three summers and two winters. One of these vessels it is proposed to station at some distance within the entrance of Smith's Sound, while the other would advance as far as possible to the northward, preserving communication with the dépôt vessel. From the point reached by the other, sledge parties would start in the early spring and explore the unknown region in various directions. By this means a wide extent of coast-line would be discovered, and a safe return would be ensured; for the advanced parties would be able to fall back upon their consort, whence, in case of accident, the whole expedition could retreat to the Danish settlements in Greenland.

The direct advantages offered by this route are, the discovery of the northern side of Greenland, and the prospects of securing the most valuable results in the various branches of scientific research,—in geography, hydrography, botany, zoology, ethnology, geology, geodesy, and meteorology: but all the advantages to science cannot possibly be foreseen. Among the possible results enumerated by the Geographical Society are these:—Completing the circle of Greenland, ascertaining the extent and nature of its northern point, and discovering the conditions of land and sea in that area; supplementing the investigations of the *Challenger* expedition as to the bottom of the ocean; the probability of forest vegetation, proved to have flourished on what is now the Greenland coast, having extended over the Pole itself, thus confounding all previous geological reasoning as to the climate and conditions of the globe during the Tertiary period; a more complete knowledge of the teeming life of the Arctic Ocean; a knowledge of the customs and mode of life of the supposed dwellers in the unknown area, of whose former existence there is proof, who have no communication with the most northern known people, and who have probably been isolated for centuries; a knowledge of the kinds of microscopic vegetation inhabiting the northern Greenland seas, which would throw great light on investigation into the age of the rocks of our own island, and on the later changes of the climate of the northern hemisphere, besides the geological results, in rocks and fossils, and the observations on glacial action, which would be yielded by the examination of a long coast line; observations of the pendulum and of the dip and intensity of the needle; and observations as to temperature, pressure, winds, and currents. These manifold advantages, of the highest importance—in spite of the vague Philistine tirade of the *Times*—are confirmed and supplemented by the documents of the other societies.

As to the element of danger, it is clearly shown in the Linnean Society's paper that, as compared with explorations in Africa, Australia, and elsewhere, Polar voyages, North and South, show a comparative immunity from loss and hardship; and during the last few years experience has been so fruitful in her teachings, that the element of discomfort and danger may now be reduced to a minimum. The Geographical Society concludes its documents by adding to the other advantages that another generation of naval officers will be trained in ice navigation,—and they will be needed in 1882,—that opportunities will be offered for distinction, and that a great benefit will be conferred on the Navy, and through the Navy on the country. The belief is expressed that all classes of the people will unite with men of science in the desire that the tradition of Arctic discovery should be preserved and handed down to posterity, and that Englishmen should not abandon that career of noble adventure which has done so much to form the national character, and to give our country the rank she still maintains.

All this is irresistible.

* * *

FORESTRY IN ITS ECONOMICAL BEARINGS

To what extent the climate of any portion of the surface of the earth can be changed by human labour is still an open question. Certain districts of the globe we are accustomed to look upon as condemned by Nature to perpetual sterility. The arid deserts of Africa and Central Asia, the frozen realms of Siberia, appear as if predestined to a gloomy lifeless solitude. To reclaim them to human control and human habitation may be one of the problems of the future. That climates have changed materially within recent times, we know as a historic fact. Macaulay has made us familiar with the damp fogs and perpetual rain-clouds with which our island was invested during the period preceding the arrival of the Danes and the Saxons. Much of the amelioration of climate which has since taken place is doubtless due to the increased cultivation of the land, and the extent to which the fen-districts have been drained; but the main agent has probably been the destruction of the forests which then clothed a large portion of the island.

The mode in which forests act in increasing the amount of moisture in the atmosphere is much misunderstood. Even in an article which recently appeared in the pages of so well-informed a journal as the *Pall Mall Gazette*, it is affirmed that this effect is due to the attraction exercised by the trees on the rain-clouds. The principle by which trees act in effecting this is, however, at least mainly, by acting as pumps in drawing up the superfluous moisture from the soil. The most trustworthy experiments show that, under normal circumstances, plants have no power of absorbing through their leaves water, either in the fluid or gaseous state; their supplies are obtained entirely through their roots; and the superfluous moisture is evaporated from the leaves. The amount of aqueous vapour thus delivered into the atmosphere by vegetation is enormous, and has been the subject of careful investigations by French and German botanists. Von Pettenkofer recently detailed* some experiments on the amount of evaporation from an oak tree, made during the whole period of its summer growth. He found the amount gradually to increase from May to July, and then decrease till October. The number of leaves on the tree he estimates at 751,592, and the total amount of evaporation in the year at 539·16 centimetres of water. The average depth of rainfall for the same period on the area covered by the oak tree would be only 65 centimetres; the amount of evaporation is thus 8⅓ times more than that of the rainfall. The excess must be drawn up by the roots from a great depth; and thus trees prevent the gradual drying of a climate, by restoring to the air the moisture which would otherwise be carried to the sea by streams and rivers.

The immediate result, therefore, of the diminution of forests in a thickly-wooded country will be to increase the proportion of the annual rainfall that is carried to the sea by the natural drainage of the country, and proportionately to decrease the amount returned insensibly to the atmosphere, which then condenses into rain and cloud. Within certain limits it is obvious that this must be an unmixed good; but as the country becomes more and more thickly populated, and the land more

† Sitzungsberichte der k. bayerischen Akademie der Wissenschaften zu München, 1870, Band 1, Heft 1.

valuable for habitation or culture, the danger rather lies in the other extreme, that the country will become so denuded of forests as to render the climate too dry for the profitable pursuit of agriculture. This has, in fact, taken place of late years to so great an extent as to demand the most serious attention. In many parts of the continent of Europe great efforts are now being made to restore a portion of the forests which have been ruthlessly destroyed. At one Government establishment in Dalmatia five million young trees are now in cultivation for this purpose. In our Indian possessions the evil resulting from the destruction of the forests reached some years ago so gigantic a dimension as to demand the instant interference of the Government. The Indian forests are in themselves a source of great revenue, producing the most valuable teak, and multitudes of the more ornamental woods used in cabinet-work. But, independently of this, the most injurious consequences had resulted to the climate from their wanton destruction; the droughts, becoming constantly more frequent and of longer duration, brought terrible famine in their rear; and the swollen water-courses, when the rain did come, caused fearful devastations. The Government at length took the subject up, and in all our Indian Provinces the Conservancy of Forests is now an important branch of the Administration, though much yet remains to be done in consolidating and perfecting the system. In Mauritius similar results have followed similar causes. The fertility of the island has been diminished by the destruction of the forests; and the fever which a few years since decimated Port Louis is attributed to the malaria occasioned by the floods brought down by the torrents swollen far beyond their ordinary dimensions.

The literature of Forest Conservancy is, in fact, now enormous. The standard work on the subject, as far as India is concerned, is by Dr. Cleghorn,* the Conservator for the Madras Presidency, which gives a history of what our Government has been doing there. We are constantly receiving, however, from others of our colonial dependencies, official reports of the efforts being made in them for the preservation of the native forests; and it is impossible in this connection to avoid mentioning the name of Ferdinand von Mueller, the accomplished Curator of the Botanic Gardens at Melbourne, whose exertions in the introduction and acclimatisation of Australian forest trees in other climes have been unwearied and of inestimable value.

In Algeria the same tale is told as in India. Up to about the year 1865 the wanton destruction of the forests by the Arabs by fire and other means, was enormous; until at length the French Government took up the subject, ably aided by one or two English and French owners of land in the Colony. The tree found there most efficacious in repairing the waste, is not a native, but one of the family known in Australia as "gum-trees," the *Eucalyptus globulus* of Tasmania. The great advantage of the planting of this tree is, not only the value of its timber, but its prodigiously rapid growth, said to be fully twenty times greater than that of the oak. It has been introduced also with great success into the South of France, owing to the energy and enterprise of v. Mueller, and is hardy in this country. The foliage is said to secrete a gum-resin, which acts as a most valuable antidote to malaria fever.

In the French department of the Hautes Alpes, an interesting experiment has been tried of a somewhat different character. The same results had there ensued from the same causes. Year by year the mountain villages had been abandoned, and in twenty years a diminution of population to the extent of 11,000 had taken place. An attempt to replace the forests met with the most violent opposition from the peasantry, and they were allowed to substitute "gazonnement" for "reboisement;" that is, the people were compelled to returf the barren and neglected districts. The effect is said to have been most beneficial. The fresh covering of the naked soil has prevented evaporation, and has allowed the rain to sink in instead of running off in destructive torrents; and districts which a few years ago were abandoned to desolation are now gradually acquiring a luxuriant vegetation, and giving food and shelter to the flocks and herds which had long been strangers to them; the streams are becoming clearer and less violent, and the bridges are no longer periodically carried away.

There is probably no department of Science to which human energy and ingenuity could be more profitably turned than the reclaiming of the waste places of the earth.

DANA ON CORALS

Corals and Coral Islands. By James D. Dana, LL.D. &c. (Sampson Low and Co., 1872.)

THE distinguished naturalist, geologist, and mineralogist, who is the author of this semi-scientific work, is probably, next to Charles Darwin, the man from whom an expansive book on coral formations would be expected. He has had immense opportunities for the careful investigation of all the phenomena of coral reefs, and his peculiar mental constitution has assisted him in all his endeavours to teach and to arrange. No geologist has equalled Dana in the arrangement of his work; and his celebrated book on that science is eagerly studied by teachers of all degrees. As a student of details, he may point to his Mineralogy with great pride; yet, with these powers and gifts ready at hand, Dana produces, late in life, this disappointing book. It is full of precious stones in ugly settings, and the gems are intermixed with much that is worthless. To the general public it will be almost a closed book for years and it is hardly worthy of a place in a purely scientific library. A great portion of the book is taken up by descriptions and remarks upon animals which are not corals, and which in no way affect or produce coral reefs or islands, and the old errors respecting coral productions are perversely introduced. All the notices and descriptions of the Actiniæ and Hydroidea might have been omitted, as they only confuse the subject, and surely such statements as refer coral making to (1) Polyps, (2) Hydroids, (3) Bryozoa, (4) Algæ, might have been left buried in the memories of those who have been teaching that the third and fourth named organisms have nothing to do with coral any more than oysters and sunflowers.

Writing about Actiniæ, Dana gives the following without reference:—"As to senses, Actiniæ, or the best of them, are not so low as was once supposed; for, besides the general sense of feeling, some of them have a series of eyes placed like a necklace around the body, just outside of the tentacles. They have crystalline lenses, and a short optic nerve. Yet Actiniæ are not known to have a proper nervous system; their optic nerves, where they exist, are apparently isolated, and not connected with a nervous ring such as exists in the higher radiate animals." Now, the "bourses marginales" have highly refractile cells and elongated cells without nematocysts associated with them; then a mass of granular and opaque tissue separates them from some irregularly-shaped cells which are not peculiar to the spot, but which are found between the muscular layers also. Corresponding refractile cells are to be found on the tentacles. We have followed Schneider in these researches, and do not as yet feel disposed to recognise an optic organ.

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* "The Forests and Gardens of South India." By Hugh Cleghorn, M.D. F.L.S. (London: W. H. Allen and Co., 1861.)

The classification of the corals employed by Dana is, as might have been expected, not that followed by those men who have raised those Radiata from the Slough of Despond in which they were left by the predecessors of Lamarck. The introduction of American novelties, to the exclusion of well-recognised European classifications, is neither right nor scientifically correct. For instance, Dana mentions the "Oculina tribe, or Oculinaceæ," and, after giving his differentiation, proceeds:—"The Orbicella is an example of one of the massive Astræa-like forms constituting the Orbicella family, or Orbicellidæ, in the Oculina tribe. The Caryophyllia here figured (*Caryophyllia Smithii*, Stokes) is one of the solitary species of the tribe found in European seas and on the coast of Great Britain." "The corallum of an allied species (*Caryophyllia cyathus*)," Dana proceeds to inform us, is found "not only in the Mediterranean, but also over the bottom of the Atlantic, even as far north as the British Isles." "Another example of this tribe, as defined by Prof. Verrill, is the species of *Astrangia* occurring alive along the southern shores of New England, and on the west of New Jersey." The diagnosis of the Oculina tribe was the growth of the experience of Schweigger, and of Milne-Edwardes, and Jules Haime, and they separated the incongruous genera which Lamarck had associated with it. The admission of Orbicella, which is really the old Astræa of Lamarck, and of Caryophyllia into this well-differentiated tribe, is simply absurd, for they possess structural characters sufficiently diverse as to place them in different families. The discovery of *Caryophyllia Smithii* in the European seas was due to the investigations of the results of the late deep-sea dredgings of H.M.S. *Porcupine*, and those unrecognised workers have shown that it is not *Caryophyllia cyathus*, but *C. clovus*, which has the great horizontal range. Had Dana waited a little longer he would have had the opportunity of quoting correctly. Again, Astrangia was well differentiated long before Prof. Verrill was heard of. The American Conrad, and our Lonsdale, and finally, the distinguished French Zoophytologists, for whose labours our author appears to have a supreme contempt, inasmuch as he rarely gives them credit for their good work, consolidated the genus, which has nothing in common with the Oculinidæ.

Interesting and valuable chapters on the distribution of corals according to temperature, and on their limitation to certain areas, follow. Darwin is supported in his views of the 20-fathom range of reef-building corals, and some interesting data are given respecting the rapidity of growth of corals. A madrepore is stated to have grown 16 feet in 64 years; but the rapidity of growth depends upon the habit of the species, the freedom from the destructive effects of boring mollusca, nibbling fish, and wave-breaking, and is, under favourable conditions, very rapid. The chapters on the structures of coral reefs and islands add little to the knowledge which Darwin and Jukes and Hochstetter have given us; but Dana's great powers of illustration enable him to reproduce the details with which we are so familiar, thanks to these authors, in very engaging forms. He tells us, however, that in the reef, "The coral *débris* and shells fill up the intervals between the coral patches and the cavities among the living tufts, and in this manner produce the reef deposit, and the bed is finally consolidated while still beneath the water."

Noticing, then, the great power of the force of sea wave in smashing and removing masses of coral, and the effects of the passage upwards on to the beach of hard blocks in destroying and comminuting smaller zoophytes, Dana very properly insists upon the formation of what are usually called coral islands, from the collection of beached coral boulders, and suggests that the extreme grinding and pounding of the most fragile coral stems places the carbonate of lime, of which they are composed, in the best position for solution in highly aërated sea water. He notices the formation of mud in and about the reefs, and compares its origin to that of any other kind of sand and mud. "It takes place on all shores exposed to the waves, coral or not coral, and in every case the gentler the prevailing movement of the water the finer the material on the shore. In the smaller lagoons, where the water is only rippled by the winds or roughened for short intervals, the trituration is of the gentlest kind possible, and moreover the finely pulverised material remains as part of the shores." He shows that the particles of the very fine mud which is washed out from the beach sands accumulate only in the more quiet waters some distance outside of the reef, and within the lagoons and channels where it settles.

After remarking upon the abundance of fish around coral islands, especially in the instance of Taputenea, with an area of six square miles, whose population of 7,000 is supported by fishing, Dana notices the drifting of logs of wood on to remote islands. "An occasional log drifts to the shores, at some of the more isolated atolls, where the natives are ignorant of any land but the spot they inhabit, they are deemed direct gifts from a propitiated deity. These drift logs were noticed by Kotzebue at the Marshall Islands, and he remarked also that they often brought stones in their roots. Similar facts have been observed at the Gilbert Group and also at Enderby's Island and many other coral islands of the Pacific. The stones at the Gilbert Islands, so far as could be learned, are generally basaltic or volcanic, and they are highly valued among the natives for whetstones, pestles, and hatchets. The logs are claimed by the chiefs for canoes." These waifs and strays, and others, like the large masses of "compact cellular larvæ" lying 200 yards inside of the line of breakers on Rose Island, and the fragments of pummice and resin which, transported by the waves, are collected by the natives on their shores, are very interesting and suggestive to the botanist, mineralogist, and archæologist—more so, perhaps, than to the natives, who are not admired by Dana, for they evidently lead too carnal an existence, and care little for poesy and the imagination.

After explaining the origin of gypsum in some of the smaller completed atolls by evaporation of sea-water in the gradually drying lagoon, Dana describes some of the guano deposits which collect on the coral limestone and saline mud, and mentions how these accidental additions with the stones and drift wood, explain many difficult geological and mineralogical problems. "Some interesting pseudomorphs occur buried in the guano of Baker's Island. Coral fragments of various species were found that had long been covered up under the deposit, and in some of which the carbonic acid had been almost entirely replaced by phosphoric acid. On such I have found 70 per cent. of phosphate of lime." This is an interesting fact, especially when it is remembered that birds' dung may have collected in all climates during many geological ages. The description of the geographical distribution of coral reefs is followed by a most interesting chapter on changes of level in the Pacific Ocean. The irregularity of the elevations and subsidences, even on confined areas, is admirably demonstrated. The formation of compact white limestones, and of impure or argillaceous limestones, and of beach or sand-drift rocks and oolitic limestones, is explained, but without reference to the admirable researches of Nelson, whose labours in the Bermudas are classical amongst European geologists. Then there is a sweeping assertion that deep-sea limestones are seldom if ever made from coral island or reef *débris*, and that lands separated by a range of deep ocean cannot supply one another with material for rocks.

The words "deep sea" are now differently understood to what they were in the days when theoretical views of the depth took the place of the results of real measurements, so that it is necessary to assert that abyssal seas may prove such barriers. But research into the lithology of the Atlantic near the Azores distinguishes mineral matters which, in all probability, are of American origin; and both in the Miocene deposits of the West Indies, and in those of the same age in Europe, there are proofs of the enormous aggregation of coral *débris* in deep limestones. Dana considers that the views, so ably put forward by Lyell and many American geologists concerning the derivation of the sedimentary rocks of the Appalachian strata from land to the east—that is to say, to the area of the present Atlantic—are unsound, because the wreck of the hypothetical continent could not have passed along the floor of the deep intervening sea. He states that the Atlantic would get back all its own dirt—an observation which would be trenchant enough, if geology did not prove the extraordinary distances to which sediments were removed from their sources.

The author is too keen a geologist not to notice this discrepancy in the size of the existing coral-limestone formations and those of the past, and he illustrates the possibility of considerable areas being now the seat of coral-limestone deposits by quoting the geography of the Abrolhos banks. The coalescence of the coral banks in shallow seas whose currents were not sufficient to cut deep and wide channels would account for the widespread and continental limestones.

An interesting notice of the occurrence of chalk in a raised reef in Oahu, near Honolulu, but which contained no traces of Foraminifera, is succeeded by essays on oceanic temperature and oceanic coral island subsidence. The Gulf-stream is stated to have had, from the Jurassic period in geological history onward, the same kind of influence on the temperature of the North Atlantic Ocean which it now has; and the British oolitic reefs are quoted as substantiating this assertion. Certainly during the Miocene the isthmus of Panama was under water, and vast tracts of the north of South America, and of the south of North America, and therefore the existence of a Gulf stream at that time may be doubted. Then there were stupendous reefs in the Italian and Austrian area, and the influence of anything like a Gulf stream would have had no effect upon them.

After noticing that coral islands are evidences of buried lands, Dana insists that "we are far from establishing that these lands were oceanic continents. For as the author has elsewhere shown, the profoundest facts in the earth's history prove that the oceans have always been oceans." This dictum is constantly in the mouths of some geologists, and its value may be appreciated by the remembrance that the existing continents are mainly composed of old sea, deep sea, and abyssal floors, and that very probably there has always been a comparatively exact relation between the amount of land and sea on the earth's surface. Moreover, there are very strong reasons for believing in a former Atlantis, and in a continent or a series of great islands between South America and New Zealand.

The illustrations of the book are numerous, and some of them are very correct representations of nature. The group of Caryophilliæ in page 42 is excellent, but British aquarium-keepers will hardly recognise the well-known *Carophyllia Smithii* on page 67. Many of the white etchings on the black ground are beautifully executed, and copies of them will make excellent diagrams.

P. M. D.

OUR BOOK SHELF

Bird-Life. By Dr. A. E. Brehm. Translated from the German by H. M. Labouchere, F.Z.S., and W. Jesse, C.M.Z.S. Parts iv. and v., 1872. (London: Van Voorst.)

THIS is a translation of a work well known in Germany, where it has attained great and in some respects merited success. "Das Leben der Vogel" is the production of one of a talented family, who have done much to popularise several branches of natural history. We do not say that it was not worth translation, but we do affirm that the translation is not worth half-a-crown a number—the price at which it is issued in this country—even when the value of Mr. Keuleman's nicely tinted lithographs is taken into account The idea of Brehm's book is to give a popular account of the way birds pass their lives in general and on particular occasions In the parts of the translation now before us the chapters relate to the "every-day-life," "courtship and marriage," "nest-building," and "migration" of birds. These are all described nicely enough, the author being an excellent field naturalist, and with sufficient accuracy, though in a very desultory manner. Anecdotes are often given from other authors, and stories from Dr. Brehm's personal experience, which has been extensive. But the work is a mere sketch of a history which it would occupy many volumes to relate in a satisfactory manner. And, as we have already said, it is certainly not worthy of the luxurious paper and excellent print lavished upon it in the translation. In short, *le jeu ne vaut par la chandelle.* Messrs. Labouchere and Jesse might have spent their time and money in many other ways, to the greater advantage of natural history and of their own pockets.

Notes on River Basins. By Robert A. Williams. (London: Longmans and Co., 1872.)

THE river basins to which this little book refers are those of Great Britain and Ireland, and the notes are published, the author says, in the hope that they may be found useful to pupil-teachers. They are intended to form a supplement to the usual text-books of school geography. The rivers of England are given first, then those of Scotland and Ireland, each system being preceded by a general sketch of the course of the water-shed (or "water-parting," as Mr. Williams prefers to call it) of the country to which it belongs, and followed by a section on the canals. The author commences at one end of each country, takes the rivers in their order round the coast, names the drainage basin and source, describes the course and mouth, takes up and describes each tributary and affluent as it occurs, names and gives the measurements of any lakes which may be in the way, mentions the most remarkable features, and ends by giving the length of the main river and the area of its basin. So far as we have tested it the information seems in the main accurate, and the list of rivers and tributaries is remarkably full. Mr. Williams mentions the fall of the Rumbling Bridge on the Devon, a tributary of the Forth, but takes no notice of the equally high and equally grand fall of the same name on the Bran, a tributary of the Tay. It is surely very unusual to spell Dunkeld "Dunkield." The book will be useful to all who wish to have the main details concerning British rivers and canals carefully and clearly arranged in a handy form.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The late Meteoric Shower

WE have had here, and I presume you also have had in England, quite a fine display of shooting stars from the fragments or companions of Biela's comet.

On Sunday evening, Nov. 24, they were coming about as fast as in the thickest parts of the August sprinkles—that is, forty or fifty to the hour, for a single observer. Three-fourths of them radiated from γ Andromedæ and vicinity.

On Monday morning there was no special abundance, but the radiant was then quite low in the north-west.

Monday evening they were coming with about half the frequency of the previous evening. Half of those seen came from the Andromeda radiant.

Tuesday evening the sky was overcast, but Wednesday evening there was so great a display as to attract the attention of multitudes. Our party of from two to six persons counted 1,000 in a part of the first hour—that is, from 6h. 38m. to 7h. 34m., and in the next hour and a quarter we counted 750. The display was rapidly diminishing. Before midnight it was essentially over, and, so far as I know, has not re-appeared.

The flights were slower than those of the Nov. 14 period, and generally faint. The radiant was carefully observed on Wednesday evening by Prof. Twining and myself, and we argued that the centre was in the line from the Pleiades to γ Andromedæ produced, and was about 3° beyond that star. It was much longer in right ascension than in declination, and was not less than 8° long. The star γ was within the radiant area, for flights in the several directions from the radiant would, if produced backward, pass sometimes on one side and sometimes the other of that star.

The character of this display, and the previously observed division of the comet into two parts, will, I doubt not, incline astronomers to the opinion of Dr. Weiss and others, who think that the shooting stars are products of the disintegration of comets already moving in closed orbits, rather than to the opinion of Prof. Schiaparelli that they are drawn from the stellar spaces into long parabolic currents. The latter hypothesis presents difficulties which I cannot explain.

Yale College, Dec. 2 H. A. NEWTON

IF the following translation of a letter I have received from Father Denza, Director of the Royal Observatory at Montcalieri, in Piedmont, will be of interest, it is at your service.

R. P. GREG

"Dear Sir,—A great shower of luminous meteors has just been witnessed throughout this country, and has no doubt been seen elsewhere. As soon as it became dusk falling stars were observed to fall continuously until midnight, and had it not then become cloudy no doubt they would have been seen until a still later hour. About 33,400 meteors were here counted by four observers. Even this number does not adequately represent the probable actual numbers. About 8 P.M. (when in some parts of the sky there seemed a real rain of fire) it was difficult to keep count, especially of those meteors appearing near the zenith; and at one time our four observers counted on the average 400 meteors every minute and a half. All the wonderful and beautiful appearances reminded us of the November shower. The meteors appeared of various colours; some left brilliant streaks; fireballs were frequent, some with an apparent diameter nearly equal to the moon's; some here and there breaking up in a thousand ways, as into a luminous cloud, or opening out into bundles of rays of singular shapes. From time to time some of these nebulous trains or appearances pursued their courses; or now vanishing or halting, only again to reappear. One of these, which appeared at 6h. 35m. between Perseus and Auriga, remained visible until 6.56, or 21m. after its first becoming visible. In short the general aspect of the phenomenon was that of a cosmic cloud which, encountering our atmosphere, appears and then melts away. The position of the *radiant*, which was accurately determined, was almost close to γ Andromedæ, and the epoch of the appearance induces one to suppose that the meteoric stream which we have just been traversing, and which in fact has been more or less seen every year, though with much less intensity might be the same which was seen by Brande, December 7, 1798, and again noticed on the same day in 1830 by the Abbé Raillard; in 1838 by Herrick and Flangergnes; later again in 1847 by Prof. Heis, of Münster; and in 1867 was recognised by Signor Zerioli at Bergamo. At the present time its point of contact with the earth's orbit must have taken place on November 27-28. Now it results from sufficiently probable calculations, that this meteor stream marks the orbit of the so much celebrated comet of Biela, the appearance or passage of which we have been expecting in the month of October of the present year, and for which astronomers are on the look-out. Most probably the large meteoric stream or cloud which produced this remarkable shower of falling stars last evening belongs to a part of this comet; so much the more likely when we consider that only yesterday the earth passed through one of the two nodes of this comet's orbit.

"A fine rose aurora was visible last evening from 6 to 8 P.M., adding to the beauty of the entire phenomenon.

"Yours respectfully,

"DENZA

"Montcalieri Observatory, Nov. 28, 1872

"P.S.—The shower was seen by many other Italian observers and astronomers—by Gasparis at Naples, who noted two meteors per second; Prof. Eugenio at Matera with three assistants counted 38,153 meteors between 6 and 12 o'clock; at Messina the number was too great to count; at Mandori Prof. Bruno and three assistants counted 30,881 meteors between 6h. 18m. and 14h. 15m.; at Ancona were counted 5,000 meteors per hour. The maximum appearance generally at all these stations was about 8 P.M., and the radiant was found to be not far from γ Andromedæ."

WHILE going to the Naval Observatory on the evening of November 27, I noticed many shooting-stars, and made the following observations:—From 6h. 25m. to 6h. 43m., Washington mean time, I counted one hundred meteors; and from 7h. 40m.

to 8h. 0m. I counted fifty meteors. The observer's face was north-west. The sky was clear to within ten or fifteen degrees of the horizon. The meteors were generally very small, and I noticed only four or five near the zenith that left trails behind that endured a few seconds. In one respect the meteors were remarkable: they all appeared to radiate from a point between the great square in Pegasus and the chair in Cassiopeia, so that during my two watches I saw but a single meteor that could properly be called sporadic. By laying down some of the tracks on a globe, I found the following rough position of the radiant point:—

$$A R = 355°, \quad \text{Decl.} = + 43°.$$

From this position of the radiant point I have computed the following elements of the orbit of the meteoric stream, and by the side of these have placed the corresponding number of Biela's comet:—

Meteoric Stream.		Biela's Comet	
π =	89·5°	π =	109·0°
Ω =	246·1	Ω =	245·9
i =	15·4	i =	12·6
$\log q$ =	9·976	$\log q$ =	9·933

These elements are so much alike, that there can be but little doubt that the meteors are the transformed particles of Biela's comet.

ASAPH HALL

Washington, Dec. 1

ON the evening of November 27, Prof. Tingley, of Asbury University, Greencastle, Indiana, observed a remarkable shower of falling stars. The number counted in 40 minutes, from 7h. 15m. to 7h. 55m., was 110. This would give 165 per hour for one observer. But according to Prof. Newton (*Silliman's Journal*, for January 1868, p. 80), the whole number visible at any station, when the sky is entirely clear, is five times the number seen by a single observer. The enumeration by Prof. Tingley accordingly indicates an actual fall of 825 per hour.

It was remarked by the writer several years since[*] that the last days of November were worthy of close attention as the probable date of a meteoric shower. The same period had been previously designated by Mr. R. P. Greg, as an aërolitic epoch. The observed showers of falling stars which may be referred to this stream are as follows:—

A.D. 837, Nov. 12, cor. to Nov. 27 for 1850.
899, 18, Dec. 2 „
1850, 29
1872, 27

The epoch corresponds with that at which the earth crosses the orbit of Biela's comet. This body is no longer visible in its cometary form, having undergone the process of disintegration—a process which doubtless *commenced* at a very remote period. The fact, then, can scarcely be doubted that the meteors of this epoch are the results of this comet's gradual dissolution.

DANIEL KIRKWOOD

Bloomington, Ind., Nov. 28

THE aurora of Nov. 27—the evening of the meteoric display—was seen by me near Liverpool. It appears to have been very partial in its manifestation, to judge by the published accounts. There was merely a hazy or diffused cloudy light, devoid both of colouring and symmetry of form. This variety of aurora I have observed on several occasions, when it appears to have attracted but few observers.

I may draw attention now to the fact of another display of aurora on Nov. 10 (noticed first at about 11.20 P.M.). This was of the usual form, ruddy, and radiating from a horizontal band of light in the north. It was followed by a week of much colder weather than had preceded it.

Liverpool, Dec. 13 SAMUEL BARBER

AS the number of meteors which I counted on the evening of Wednesday last, November 27, varied considerably from the number in Mr. Lowe's tables (*Times*, November 29), I beg to offer you my observations, in case they should be of any value on account of the more southern point from which they were taken. I lay down on my back upon the flat roof of the house in which I live, and looked up towards the zenith. The radiating point of most of the meteors seemed to be in the area between Cassiopeia and Perseus. I observed a bright one between the stars representing the feet of Andromeda. It disappeared without traversing almost any visible track or angular distance, from which I drew the inference that it was near the radiating point. The number I counted was as follows:—

Time. h.	Time. m.	No. in 5 minutes.	Average No. per minute.
6	34—39	150	30
6	39—44	140	28
6	45—50	150	30
6	50—55	180	36
7	1— 6	160	32
7	7—12	160	32
7	17—22	170	34
7	30—35	180	36
7	40—45	180	36
8	48—53	150	30
10	5—10	80	16
10	24 29	70	14

Between 8 and 8.30, a friend and I counted together about 50 per minute.

J. F. ANDERSON

Pau, Dec. 2

The De Novo Production of Living Things

IN reply to Mr. E. Ray Lankester's inquiry in the last number of NATURE, I beg to state that the specific gravity of an infusion of turnip, prepared in the manner I have directed, was found to be 1012, whilst that of an infusion of hay was 1005.

H. CHARLTON BASTIAN

University College, London, Dec. 16

The Ocean Rainfall

ON reading the article on "The Meteorology of the Future," in NATURE, December 12, I pondered over this passage—"It is impossible to determine the rainfall over the ocean;" and it occurred to me that it is possible to do something in that line approximately. Is the *Challenger* supplied with rain-gauges? Would it not be possible to determine in some measure the hourly amount of rainfall over the ocean, in the zones of greatest precipitation, or in those of periodical rains, without detaining the ship unduly; and would not such data be useful in solving some of the problems connected with the working out of the law of cyclones?

Another suggestion has occurred to me—that is, that rain-gauges might be placed in "floating lights," and the rainfall at sea thus obtained. I need not now inquire through what channel this might be effected, or what particular structure and fixing of the gauges might be necessary. I should be glad to elicit the opinion of some of the readers of NATURE as to the practicability and utility of such a scheme.

S. H. MILLER

Wisbech, Dec. 14

Ocean Meteorological Observations

AN examination of the discussion of the daily range of the barometer for square No. 3, published under Fitzroy's direction in 1861, which Mr. Symons has referred to at page 68 of this volume, shows that the results there arrived at can only be considered to be good as corrections for hourly observations of the barometer on the mean of the year. As regards the months, the results are, on account of the fewness of the observations on which they are based, too imperfect as indications of the true range to be available in correcting the averages on the large January chart issued by the Meteorological Committee. Since, moreover, the barometric range for January differs from that for the year, the hourly corrections for range on the mean of the year should not be applied to the January observations printed on the large chart.

Again, the prevalence in January of the south-easterly trades in the southern portion of the square, the prevalence of the north-easterly trades in the northern portion, and variable winds between, and the unequally clouded state of the sky which results therefrom, render it certain that range corrections must differ considerably in different portions of the square. On these grounds, it would be a mistake, scientifically, to correct the averages of the actual observations on the large chart, in the present state of our knowledge. These should be printed with none except instrumental corrections; and as we have already said, the mean hour of the day and the mean day of the month of each average should be given; for if this be not done, the results of the discussion can be turned to no strict scientific use whatever.

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[*] "Meteoric Astronomy," p. 55.

But it is quite otherwise in discussing the data entered on the large chart, with the view of arriving at some knowledge of the distribution of pressure over this important part of the ocean. As we stated before, "such a discussion necessarily calls for a preliminary preparation of the results by the application of such approximate corrections for range as we are in possession of," and of these corrections Fitzroy's, to which Mr. Symons refers, are among the most valuable. To have attempted such a discussion, disregarding the correction for range, is a grave mistake; and we can scarcely suppose the Meteorological Committee will sanction it when they ultimately decide on the method of discussion to be adopted.

Fitzroy recognised the vital importance of range corrections in such discussions; and with this view the monograph above referred to was published under his direction upwards of eleven years ago. It would be well if a series of such monographs were prepared under the direction of the Meteorological Committee, as necessary preliminaries, which indeed they are, to the discussion of the meteorology of each portion of the ocean they undertake to discuss. YOUR REVIEWER

Rainfall at Barbados

I DO not know whether the following notice is worthy of admission into NATURE, but it suggests many interesting consequences as the effects of heavy rains over continents drained by large rivers.

A very intelligent naturalist, writing to me from Tobago, states:—

"During August we had an influx of fresh water all along our southern coast, and throughout the whole extent the sea eggs crawled ashore, and died in great numbers. No one has seen the like before. I have no doubt the fresh water was the cause of the mortality, and that other shells also suffered."

I have not the means of ascertaining the rainfall of the basins drained by the Orinoco and Amazon, but we in Barbados, and most of the islands in these seas, have been suffering for many months from a protracted drought. Have there been excessive rains on the Continent?

Tobago is at least 150 miles from the mouth of the Orinoco, and 900 miles from that of the Amazon. It is well known that the outflows of both rivers sweep round, and form a swift ocean current impinging on, and passing by, Tobago, whither they carry drift wood, seeds, and other products of the shore. But I never before heard of the quality of the water being affected to so great a distance.

I fear that no person had the curiosity to test the density or quality of the water. I shall inquire of my correspondent.

Barbados, Nov. 11 RAWSON W. RAWSON

Treatise on Probability

THERE has been no doubt as to the author or authors of the "Treatise on Probability," published under the superintendence of the Society for the Diffusion of Useful Knowledge, since 1844. In that year the "Value of Annuities and Reversionary Payments," by David Jones, was issued in two volumes by Robert Baldwin, of 47, Paternoster Row, and the title-page states—"To which is appended a 'Treatise on Probability,' by Sir John William Lubbock, Bart., F.R.S., and J. E. Drinkwater Bethune, Esq., A.M." Sir John Lubbock's name also appears on the opposite page, with his first Christian name properly affixed, and this is repeated at the end of the volume in a catalogue of the works published by that society. The treatise consists of 64 octavo pages, and was one of the best on the subject at the time it was first issued. The late Prof. De Morgan alludes to it in the English Cyclopædia, and Mr. Todhunter quotes "Lubbock and Drinkwater" no fewer than ten times in his "History of Probability," published in 1865. T. T. WILKINSON

THE HAWAIIAN VOLCANO, MAUNA LOA

THE following condensed account of the visit of a party to the summit of the Hawaiian Volcano, Mauna Loa, at present in a state of fearful activity, appears in the *Times* of November 23, from the pen of Prof. F. L. Clarke.

"From Kaalualu, on the southern side of Hawaii, where we left the steamer on the afternoon of the 4th, we procured horses and proceeded to Wiohinu, where we remained for the night, and started next morning; and, after travelling a distance of twenty-five miles over a very rough road, although it is considered one of the best, we reached Lyman's ranch, where we were kindly received, and passed the night. The following morning, at daylight, our friends having exerted themselves in procuring the services of an experienced guide, we resumed our journey, and after stopping at several ranches for rest and refreshment, during the forenoon of the 6th, we emerged from the woods, which opened upon an immense field of pa-hoe-hoe. The lava fields in this region exceed in wildness and confusion the most extravagant imagination. For miles around, as far as the eye could reach, great masses of once molten lava were tossed into a thousand grotesque shapes. After travelling several hours over the roughest kind of ground imaginable, we reached a rude kind of gateway that was formed by gigantic columns of lava rock, through which we passed, and reached the edge of a rough pali, from whence we were able to look out upon the summit. To our right rose a remarkable pillar, towering high up black against the sky, and on every hand yawned deep crevices and spent lava waves which had dashed together in various shapes and cooled.

"After reaching a favourable spot, where we left our animals secured for the night, we proceeded about 500 yards over a narrow strip of rugged lava, when we suddenly found ourselves upon the edge of the crater of Moku-weo-weo, on the very summit of Mauna Loa, situated about 1,400 feet above the sea level. Before us yawned a fearful chasm, with perpendicular black walls some 800 feet in depth, carrying the eye to where, in the darkness of the lower basin, there sprang up in a gloriously brilliant light a mighty fountain of clear molten lava, and looking across and below us, at a distance probably of three-quarters of a mile, there arose from a cone in the south-west corner of the lower basin a magnificent column of liquid lava, about seventy-five feet in diameter, that sent its volume of molten matter to a height of nearly 200 feet in a compact and powerful jet. The axis of this gigantic fountain inclined somewhat toward us, so that the descending cascade fell clear and distinct from the upward shooting jet, forming a column of continuous liquid metal surpassingly bright and beautiful to gaze upon. Flowing down the sides of the symmetrical cone, which the falling stream of lava was rapidly forming, were numerous rivers of liquid light, that as they flowed away, spreading and crossing, formed a lake of rivulets constantly widening and interlacing, which presented a beautiful and unique appearance.

"When we reached the summit of the mountain, the subdued roar of the pent-up gases was fearfully distinct as they rushed through the openings which their force had rent in the solid bed of the basin, and when we were in full view of the grand display our ears were filled with the mighty sound as of a tremendous surf rolling in upon a level shore, while now and again a mingled crash would remind us of the heavy rush of ponderous waves against the rocky cliffs of Hawaii."

Since the return of the party to Honolulu later advices state that the crater is increasing in action, and reflecting at night a light of unusual brilliancy, which reaches many miles off shore. The crater in Kilanea, since the present eruption of Moku-weo-weo, has been very irregular in its action, which leads to the supposition that the two alternate, that when one is active the other is passive.

ON THE SPECTROSCOPE AND ITS APPLICATIONS *

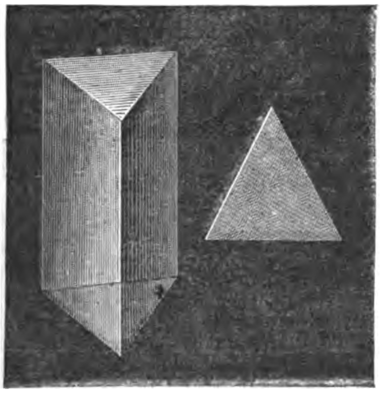

Fig. 1.—Geometrical form of the prism.

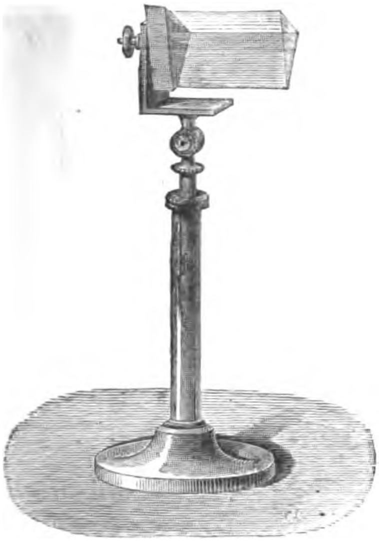

Fig. 2.—Prism mounted on a stand.

THE field of research which has been opened up by the spectroscope is one with which we have so recently become familiar, that it may almost be said that twenty years ago, a course of lectures on the spectroscope would have been an impossibility. The instrument, as we now know it, was only then in embryo, and even at the present time, although immense strides are every day being made, the science of spectroscopy must still be considered in its infancy. And yet, so far as one can see now—it is always very easy to prophesy after the event—there seems very little reason why lectures on the spectroscope should not have been given two centuries ago; for nearly two centuries have elapsed since the immortal Newton made his classical researches on the action of a prism upon sunlight. You may, perhaps, be inclined to ask, how it could take 200 years for the knowledge of the prism, and of the wonders that can be worked by it, to become part and parcel of our common stock of information? If you ask me to explain this, I tell you candidly that I cannot; but there is this grain of comfort connected with it which none of us should forget: we may almost say for certain that Newton and his successors would have brought a great deal more out of the prism than they did, if they had given a little more attention to it, and had tortured it as they did other things; that those who follow us will point to us and say the same; they possibly will say that in the 19th century, men of science, in working and experimenting, saw a great many things, and chronicled them, but did not care to go any further with them. This is very true; and the result is, that work is not done which might be done if we were more receptive and original in our methods of investigation; that is to say, if we trusted Nature more and ourselves less.

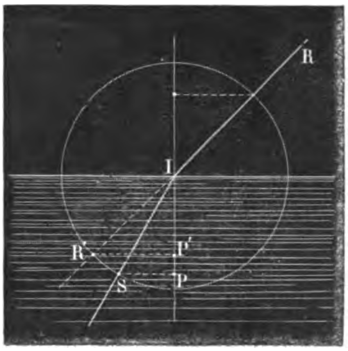

Fig. 3.—Refraction of light.

I propose that the first part of this lecture should in the main consist of an account of the prism and the principles of the spectroscope, and then of a description of the various kinds of spectroscopes which are now employed. I hope afterwards to go somewhat in detail into the applications of the spectroscope, not only with regard to terrestrial matters, but also with regard to those problems which we may possibly consider much grander, problems dealing with those celestial bodies which are sufficiently our neighbours to send us light.

Obviously, the first question we have to answer is this, What is a spectroscope? This I answer by saying that a spectroscope is an instrument in which the action of a prism or a combination of prisms is best studied. The next question, then, that arises, is, What is a prism? The accompanying figures (Figs. 1 and 2) will give a good idea of what is meant by a prism, and little time need be spent in description. It is usually a piece of glass—though it need not necessarily be so—bounded by five surfaces, two of which are parallel to each other—though they are not necessarily so—and three of which, bounded by parallel edges, cut each other at different angles; it is in reality shaped like a wedge. The importance of these different angles you will see by-and-by.

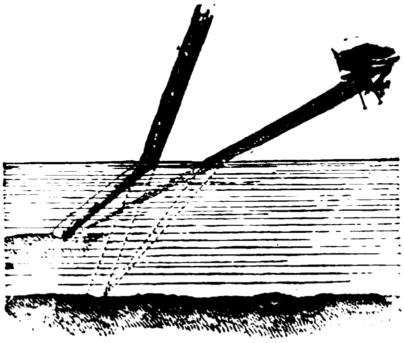

Fig. 4.—Explanation of the bent stick.

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* Revised rom the series of Cantor Lectures, delivered in 1869.

The discoveries of Newton, to which I have already alluded, were connected with prisms, and were based on well-known properties of light.

If a beam of light, as for instance sun-light or an artificial white light, be allowed to enter a dark room from a round hole in a shutter, it will simply travel in a straight line from its source; and to make it deviate from this straight line one of two things must be done. The beam must either be reflected or refracted.

The reflection of light is of very ordinary occurrence, for when light strikes any polished metallic surface, or in fact a surface of any kind, it is more or less reflected by it. The phenomena of reflection are so well known, the use of the mirror or looking-glass being perhaps one of the most tangible, that no detailed reference need be made to them. The refraction or bending of light takes place when the ray passes obliquely from one medium to another of different density, as from air into water, or from water into air. A simple experiment may be made by passing the beam of light from above into a glass vessel containing water. If the ray strikes the surface perpendicularly, it will be seen that no visible change takes place, the ray simply proceeds directly into the water without altering its direction. If, however, the beam be allowed to fall on the surface of the water, say at an angle of about 45°, two things may be observed. In the first place a reflection will take place at the surface of the water—that is to say, the light will appear reflected at the surface, and it will be noticed incidentally that the angle at which the reflected ray leaves the water is precisely equal to that at which the incident ray strikes the surface, thus proving the rule that "the angle of incidence and of reflection are equal." The second thing to be noticed is that on entering the water the direction of the beam of light will not be the same as it was in the air. In Fig. 3, the ray R I, striking the water at I, instead of proceeding to R′, is deflected or refracted to S; that is, the ray will be bent downwards, or, what is the same thing, towards a line, I P, perpendicular to the surface, to a definite extent, depending on the angle of the incident ray. The experiment may be varied by allowing the light to fall on the surface at various angles, when it can be shown that the angle formed by the ray refracted in the water varies in proportion to the angle of the incident ray, and that the angles formed are bound together by a regular law. Another fact may be observed, that the smaller the angle at which a ray of light strikes the surface of water, or, in fact, any transparent surface, the greater will be the proportion of light reflected at its surface.

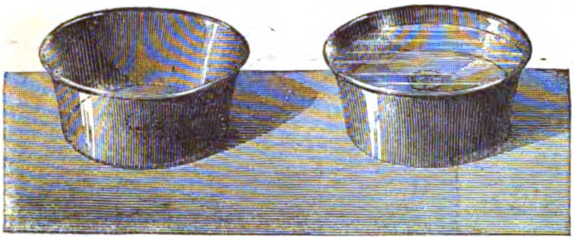

Fig. 5.—Refraction of light. Apparent elevation of the bottoms of vessels.

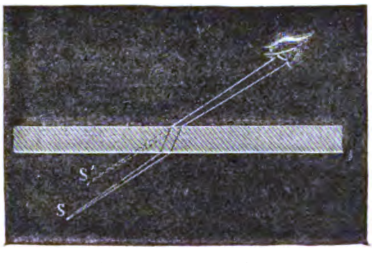

Fig. 6.—Light passing through plate of glass.

Refraction may be clearly studied by plunging a stick into a vessel of water: the stick will appear bent at the point where it enters the liquid, as in Fig. 4, thus giving the appearance as if the stick were lifted or bent upwards. Another very instructive experiment is to place a coin at the bottom of a vessel, and then, standing so that the coin is just hidden by its edge, to gradually fill the vessel with water; the coin will appear to rise with the bottom of the vessel, and will become visible, as shown in Fig. 5.

The amount of refraction varies with the medium employed, and also with its temperature. The effect of different media can be clearly seen by passing a ray of light into a vessel containing a liquid such as bi-sulphide of carbon, with a layer of water floating on the top. The ray will be seen to be bent on entering the water, and still more bent on passing from the water into the layer of bisulphide of carbon.

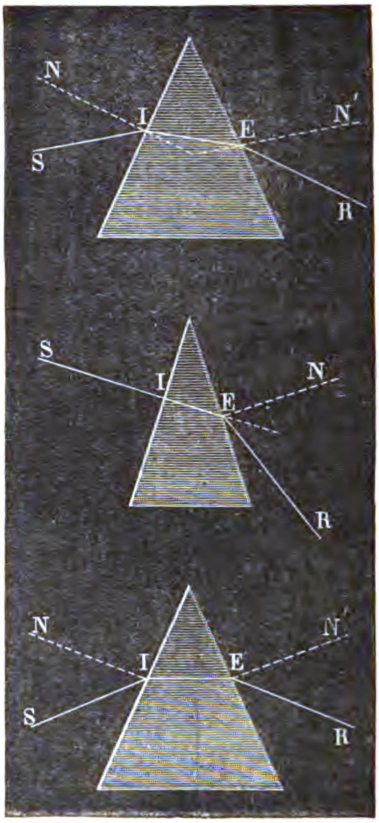

Fig. 7.—Deviation of luminous rays by prisms.

We have now to see what takes place when a ray of light enters a piece of glass. We will take first the case of glass with parallel sides. The ray on entering the glass at the upper surface is refracted downwards, as in the case of water, and travels through the glass until it reaches the under surface. Here we have precisely the reverse condition holding—that is, the ray of light passes from a dense medium to a rarer one. The ray is refracted upwards or away from the perpendicular line, and thus will exactly neutralise the previous refraction, and the beam of light will come out in a direction parallel to its original path, though not quite in the same straight line; as shown in Fig. 6, the ray, instead of proceeding in the direction of S′, proceeds in the direction of S.

If, then, a ray of light passes through a piece of glass, such, for instance, as a window glass, the surfaces of which are parallel, and inclined to the beam, you see when the beam passes through that the refractive effect is imperceptible. The reason of this is, that when we get the light falling on the glass from the air, then travelling through the glass and coming into the air again, under exactly the same conditions, what is done at the first surface is exactly undone at the second, so that we get pretty much the same effect as at first. But now, if instead of having the glass bounded by parallel surfaces, we use a wedge-shaped piece, or a *prism*, the sides of

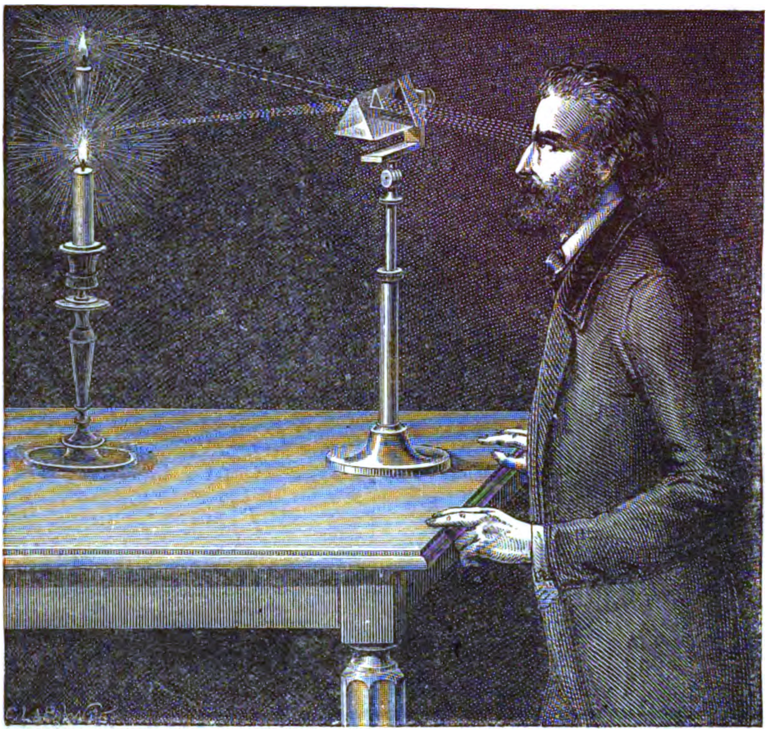

FIG. 8.—Images of objects seen through prisms.

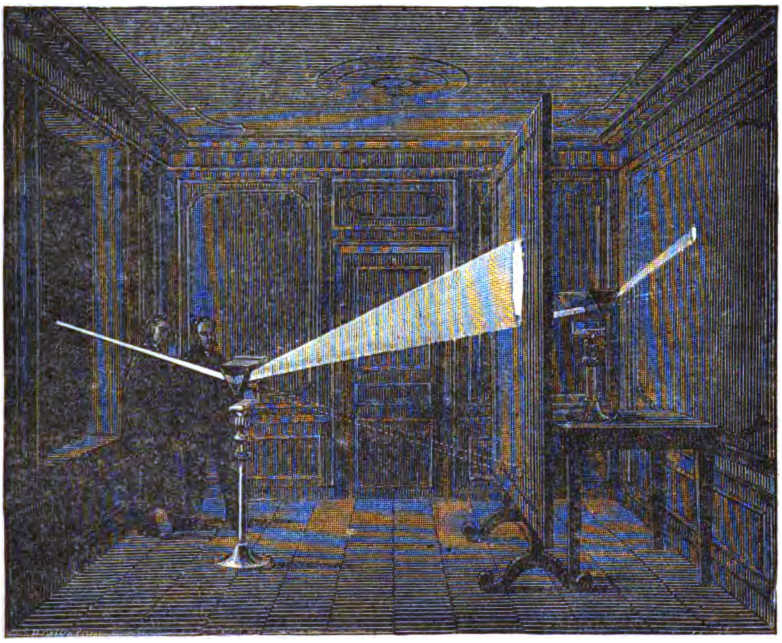

FIG. 9.—Decomposition of light by the prism. Unequal refrangibility of the colours of the spectrum

which are no longer parallel, you will see that there is a distinct alteration in the effect produced; the beam is directed to another portion of the wall altogether. The ray strikes the first side of the prism, and is bent towards the thicker part, or towards a line perpendicular to this surface, and on reaching the second side of the wedge, the ray is again bent in the same direction towards the base of the prism, for in this case the ray is bent away from the perpendicular to the second surface, and the light emerges from the second surface in a totally new direction. Fig. 7 shows the effect in three cases, the incident ray S I, the path in prism I E, and the refracted ray E R; N I and E N′ being the lines perpendicular to the surfaces. An experiment may easily be tried, which will confirm this. Let a triangular piece of glass be held, with one edge pointing upwards, between the eye and a lighted candle, as shown in Fig. 8; it will be found that the candle cannot be seen; but if the prism be gradually raised, the image of the candle will appear, the amount the prism will have to be raised depending on its angle. Now, we have here obtained a deviation or refraction of light—that is to say, it has been bent out of its course; for we have to look upwards to see the candle. Another effect has also been produced: the light which was white on entering the prism is now made up of several colours, which are separated more or less from each other; the candle, as seen in the last experiment, is not white, but is fringed round with colours. If we again take our beam of light in the dark room, as in Fig. 9, and allow it to strike on one of our prisms, so placed that its edges are horizontal, and also that the beam enters it obliquely by one of its surfaces, and then receive the image on a screen, we see a band of colours which reminds us strongly of the rainbow: the lowest colour, if the base of the prism be upwards, will be red, next above orange, passing by imperceptible gradations to yellow, and afterwards green, which then passes through the shades of greenish blue till it becomes a pure blue, then indigo, and finally ends with a violet colour. The transition from one colour to another is not abrupt, but is made in an imperceptible manner, so that it can scarcely be said, for instance, where the yellow ends or the green begins. The cause of this band of colours, or *spectrum* as it is called, was first discovered by Sir Isaac Newton, who tortured this spectrum in several ways. He took one of the colours thus produced, say red, as is shown in the figure, and made it pass through a second prism, receiving the image on a second screen; the image is found to be rather longer, but the colour remains unaltered. This experiment proves that this colour of the spectrum is simple, and the same has been found of all the others. As Newton in his experiment operated with sunlight, the band of colours was in this case called the *solar spectrum*. The rainbow itself is also in reality nothing more nor less than a solar spectrum, which is caused by refraction in the rain-drops.

If, instead of getting one beam of white light, we take two of differently coloured lights, red and blue, and pass these two beams of different colour through the same prism, you will see that the action of the prism on these two differently coloured beams will be unequal; in other words, you will get the red beam deflected to a certain distance from a straight line, and the blue deflected to a certain other distance. You see by this experiment that there is a distinct difference in the amount of refrangibility—that the red light is not diverted so far out of its original direction by the prism as the blue. And this leads us to Newton's first proposition, which is this:—"*Lights which differ in colour differ in refrangibility.*" I think that requires no explanation. You will be able to translate it for yourselves thus: Lights which differ in colour are differently acted upon by a prism, which, as you have seen, gives us a considerable result of the action of refraction.

J. N. LOCKYER

(*To be continued.*)

THE GEOLOGICAL EXHIBITION IN GLASGOW

THERE is probably no town or city in the United Kingdom, out of London, in which the science of Geology has been studied more extensively and enthusiastically, and to more purpose, than in Glasgow, during the last fifteen or twenty years. It is about fifteen years since the Geological Society of Glasgow was formed, and during the whole of that period the progress of the study and of the Society has never flagged, of which there was ample evidence afforded by a great exhibition of geological and mineralogical specimens which the Society held in the Corporation Galleries on the evening of Friday, December 6.

The Geological Society of Glasgow is one of the very few provincial societies, the results of whose scientific labours are permanently placed on record, and consulted by geologists elsewhere. The "Transactions" of the Society are now in the fourth volume, and in them there are embodied many valuable original memoirs bearing particularly on special departments of the geology of Lanarkshire and the West of Scotland.

The exhibition of the Society of which we are now giving a brief account, was chiefly devoted to an illustration of the fauna and flora of the Carboniferous system of the west of Scotland. Various members of the Society have worked most successfully in other departments of geological inquiry, but the function of the Society as a whole seems to have been especially the investigation of the Carboniferous system, and the elucidation of the many important physical problems connected therewith; and when we consider the fact that the exhibition in question was only a representation of the geological collections from which the specimens were obtained, we cannot help concluding that the Society's function has been performed with most surprising results to science.

Mr. James Thomson, F.G.S., corresponding member of the Royal Society of Liège, was certainly the chief exhibitor in the department of carboniferous fossils; but he was well supported by Messrs. Young and Armstrong. The first-named gentleman has done immense service during the last fifteen years, as a collector, particularly in connection with the fossil corals. His services in this respect have been extensively acknowledged at home—by the British Association and otherwise—and by Continental and American geologists, museums, &c. It is probable that, within the time named, Mr. Thomson has made sections of not fewer than ten thousand specimens of his favourite fossil corals. Besides the corals, Mr. Thomson's collection is peculiarly rich in reptilian remains, some of them quite unique and rare. Mr. Armstrong's specimens were generally representative of all the groups of animals and plants contained in the coal, ironstone, shale, and limestone series of the west of Scotland—Lanarkshire and the adjoining counties. Many of his cases excited great admiration. Besides being generally representative of the carboniferous system, Mr. Young was very strong in the Entomostraca and Foraminifera of that system, the species of which he has materially increased by his own discoveries.

In the department of Post-Tertiary shells, Mr. David Robertson, F.G.S., was without a competitor. Indeed, he has been such a devoted student of the Post-Tertiary period, that his collection is probably unrivalled. For a number of years the Rev. H. W. Crossley, F.G.S., now of Birmingham, was a zealous co-worker with Mr. Robertson. The Ostracoda and Foraminifera of the Carboniferous system, and the recent Hydrozoa and Polyzoa, were also largely represented in Mr. Robertson's cases.

Silurian fossils collected in the Girvan district, on the coast of Ayrshire, were shown by Mrs. Robert Gray, an enthusiastic naturalist; and from the Silurian system some interesting specimens were exhibited by Mr. Dairon, whose collection was also specially rich in Graptolites from the neighbourhood of Moffat. Mr. Dairon exhibited Liassic fossils from the Whitby district, and Mr. Bell illustrated the Liassic system of the Isle of Skye.

Mr. Wünsch, one of the vice-presidents of the Society, was as strong as any exhibitor of volcanic minerals collected by himself on Vesuvius and Etna, and in the volcanic district of the Auvergne Mountains. The same gentleman showed specimens of the fossilised remains of a primeval forest which he found in association with volcanic ash on the shores of the island of Arran a few years ago.

There is no public museum in Glasgow that is worthy of the name in which these collections could find a home. Overtures have been made, in at least one instance, to secure many of the specimens for museums or for private collections elsewhere. It will afford room for profound regret if the ultimate possession of such collections should be diverted from the west of Scotland, where they have almost entirely been collected. Surely the wealthy coalmasters, ironmasters, shipbuilders, manufacturers, merchants, and others in Glasgow and the surrounding district, are not so supremely devoted to money-getting that they cannot amongst them raise a fund of a few thousand pounds to found a museum, the geological position of which shall have as a nucleus those priceless collections already referred to. Possibly some definite shape may be given to this idea when, in the course of the next few years, the British Association holds its third meeting in Glasgow, on which occasion the Glasgow geologists will not fail to gratify the longings of their geological friends elsewhere, many of whom have but a faint idea of the intellectual feast which is in store for them.

JOHN MAYER

THE RISING OF AUSTRALIA

OBSERVING that the gradual elevation of the land in the Australian portion of the southern hemisphere is attracting the attention of European geologists, I am induced to forward a few observations thereon, based upon personal investigation.

In March last, in a letter to the editor of this journal, under the title of "Circumpolar Land," Mr. Howorth cites a passage from my paper on the geological structure of this portion of the island, viz., Hobart Town. My remarks upon these post-pliocene evidences of terrestrial elevation were necessarily brief, owing to the various formations treated of in that contribution. I now therefore beg to draw the attention of the readers of NATURE to a few instances, in detail; for the reason that I am satisfied the question is one that demands the strictest inquiry in the present stage of geological science.

Upon reading a paper before the Royal Society of Tasmania, in November 1864, on these shell deposits as evidence of recent upheaval of the coast, I found the majority of the observers there present regarded them as having originated at the hands of the aborigines; as being, in short, the refuse of their camps. But I then pointed out the fact that there were genera and species of testaceous remains far too small to have been taken by the blacks for the purpose of food. One argument at that time raised against my deductions was the fact that in some instances fragments of charcoal were found associated with the shells. Where this is the case (though the instances known to me are few) I think I shall be able to show that it is to be traced to subsequent drift agency, and has no connection whatever with the formation of these shell beds.

One of the most interesting of these deposits is to be seen at Sandy Bay, an indent of the estuary of the river Derwent, distant from the city two miles. In a bank formed by a road-cutting distant sixty yards inland, and forty feet above high-water mark, exists a shell-bed three feet in thickness. The shells have a matrix of dark argillo-arenaceous soil, and beyond being more or less comminuted, especially the bivalves, exhibit few traces of geological age. Above the shell-bed reposes a stratum of vegetable soil a few inches thick. The shells rest upon a stratum of brown clay, having no traces of organisms; and that, in turn, reposes on coarse-grained yellow sandstone, traversed by veins of marl near its surface. The shells are all of genera and species now found living in the water only sixty yards in front of and below the deposit. They principally consist of *Mytilus*, *Turbo*, *Trochus*, *Delphinulus*, *Venus*, *Pecten*, *Ostrea*, *Patella*, *Cerethium*, and *Natica*. In this bed a spoon-bowl-shaped fossil bone was found by a labourer employed in making the road, five years ago. A cast of the bone I recently forwarded to one of the first osteologists of the age for identification. I have little doubt, however, that it is a bone of the hyoidal process of some Cetacean. It is 2½ inches in length, by 2¾ in breadth, and presents no further signs of decay than the associated shells. At the distance of a mile from this spot seaward, there is another shell-deposit which has an average thickness of two feet, reposing on a basaltic overflow, and which again reposes on an arenaceous yellow clay, thickly perforated by Pholas. These beds are exposed in a vertical section of between thirty and forty feet in height.

Another locality where these evidences of recent elevation of the coast are plainly seen, is in the Queen's Demain, on the north eastern boundary of the city, and in the immediate vicinity of Government House. Here, shells are exposed in the surface soil, 500 yards from the water-line of the estuary, but they are in a finely comminuted condition. They are thickly interspersed through the beds of the Royal Society's Gardens adjoining.

In the district of Lorrel, which is fourteen miles from the last-named locality in an easterly direction, there is a long low sandy flat, whose mean elevation above the sea-level I estimate at ten feet only. The arenaceous soil of this plateau is thickly studded for about two square miles with oyster shells, some of them being much larger on the average than what are taken now. This plateau is separated from a cliff of sandstone by an arm of the sea about one mile wide and very shallow. The cliff is about eighty feet high and is known as the Bluff. On the top of this cliff is an extensive deposit of oyster shells corresponding in character to those in the flat below. Now, if a line were drawn from this bed of shells to the deposits referred to around Hobart Town, it would be found to occupy a mean altitude of these beds. The conclusion, I believe, to be arrived at from the fact of the same species of shells existing at such different levels above the sea as those on the cliff and those on the flat, is that the former are older than the latter, though both without doubt belong to the post-pliocene epoch, and that the land has been gradually rising since the shells on the cliff contained their inhabitants up to the present time. That a silting up agency has been in operation with regard to the latter deposit is evident. The oyster shells are those known as the mud oyster here, its habitat being mudbanks. Now they are found dispersed through an incoherent sandy deposit, derived from the erosion of the sandstone formations on the opposite shore. The counter-agency of such silting up is, however, infinitesimally small when compared to the scale on which the land is rising.

I might multiply these instances of recent elevation of the land, did time and space permit, by mentioning numerous other examples round the coast of this island. Leaving Tasmania, and going to the Australian mainland, we find their analogues there. While on a geological visit to New South Wales and Victoria two years ago I was struck by the exact representatives of these sea marks. In examining the shore of Hobson's Bay, Victoria, between Brighton and Mordiallac, I found recent shells in a ferruginous rock several feet above high-water mark, and exposed for more than a mile along the shore. This formation then gave place to a deposit of the same species of shells in a black sandy soil of the same character as those matrices mentioned as occurring here. I am thus able to add my humble testimony to the truth of the statements made by those geologists mentioned by Mr. Howorth. Not only do Tasmanian post-pliocene marine deposits find their analogues in New South Wales, Victoria, and other parts of the Australian mainland, but also the Miocene territory formations have their representatives there. For instance; at the East coast of this island seventy miles distant from Hobart Town, exist some very fine Miocene shell beds reposing on Silurian strata. These beds have their analogues in Victoria, at Schnapper point, where they also repose on Silurian strata. Again the somewhat celebrated Travertin deposit on the eastern bank of the Derwent, mentioned by Mr. Darwin, is completely represented at Geelong in that colony. I mention these last somewhat irrelevant features to show the analogy of physical conditions which existed in distant parts of Australasia from the middle Tertiary epoch down to the post-pliocene.

The oscillation of the land towards the Polar Regions is a question that demands strict and patient inquiry. That such a mutation is going on in this part of the globe, every intelligent geological observer is conscious of, and that at a computed rate of ten feet in the century. This is a fact which involves a variety of considerations with respect to past geological operations, and the popular theories propounded to explain them.

Although the land in this part of the globe is rapidly rising as well as according to published observations, that, in the Arctic regions, still I am in a position to show that an opposite movement took place during the close of the Tertiary or the dawn of the Pleistocene epochs by a sinking of certain tracts of land whereby Tasmania and New Zealand were isolated from the Australian mainland. I cannot do more at the present time than allude *en passant* to the important fact, and which must form the subject of a future communication.

Since writing the above I have examined a raised beach in the district of Sorrel, of many hundreds of acres in extent, composed of shells, having a mean thickness of five feet. The deposit is overgrown with trees and scrub. The trees are chiefly the Casuarina, or she-oak of the colonists, and it evidently flourishes on a soil of little else than shells. Although years ago lime burning was carried on for some years, so enormous is the deposit that there is scarcely a perceptible diminution.

Hobart Town, Oct. 1 S. H. WINTLE

THE COLOURED STARS ABOUT KAPPA CRUCIS

MR. H. C. RUSSELL, of the Sydney Observatory, sends us an account of some observations he has recently made on the above small but beautiful cluster of stars. He believes his researches probably point it out as one of the stations from which astronomers will gain fresh knowledge of the starry heavens. He gives a history of the cluster from its first recorded observation by Lacaille in 1750. Dunlop, about 1828, puts two stars in the place now occupied by ϕ, which has considerably altered its place since Herschel made his map in 1835. The star No. 87, Dunlop does not represent at all, and says nothing of colour, though fond of recording coloured stars. In 1835 Herschel wrote a monograph on Kappa Crucis, and placed all the stars (110) on his map, but saw no nebulous light. Abbott of Tasmania, in 1862, laid down 75 stars, and noted colours, remarking that certain changes were apparently taking place in the number, position, and colour of the component stars of the cluster. Nothing has been done since Abbott, till Mr. Russell determined to test for himself the latter's statement. He made a catalogue of all the stars (130) seen with the Sydney equatorial, a coloured map showing all the stars, and notes. His map takes in as much space as Herschel's, but is four times as large. A close inspection shows a great many changes since Herschel observed, of which the most conspicuous of all is in the change between the present and past position of three stars, Nos. 11, 21, and 28, which have all moved from 4 to 6 seconds; and the star ϕ has also moved half a second in an opposite direction, and come nearly, but not quite, in a straight line with δ and ϵ, which line, if produced, passes, not through ζ, as in Abbott's observations, but half way between γ and ζ. Considerable change has also taken place in Nos. 100, 106, 120, 122, 126, and some others; and it is remarkable that the changes in the south preceding line are nearly all in R. A., while in those near β and in the following side they are in declination, as if the cluster were made up of three sets of stars, two of which drift from the third in different directions. Five of Herschel's stars he could not see, but found 25 Herschel did not see; stars which, though all small, are yet in most cases brighter than some of those which Herschel recognised, and if there when Herschel examined, the cluster would not have been omitted; they are all well within the limits of his map, and several in parts of it which must have been most carefully examined. Two of them are near α, one near the string of stars south following it, one between β and δ, and two in the triangle 50s. after α, where Herschel shows 3 stars; of the others 5 precede α from 18 to 25s.; 5 follow it from 15 to 25s. and on the south side; 8 are on the north following side, and 1 on the south following. Their numbers in my list are 2, 3, 4, 6, 7, 16, 19, 31, 60, 69, 73. 76, 79, 86, 110, 116, 117, 120, 123, 124, 125, 127, 128, 129, and 130. In Mr. Russell's list there are 24 stars about the 10th magnitude, while in Herschel's there are only 7; and the mean magnitude of Herschel's 130 is 13, while the mean of Russell's 130 is 12.

These facts prove beyond all question, Mr. Russell thinks, that from some cause there has, as in the nebula of η Argus, been here a considerable increase in brilliancy.

Mr. Russell thinks that we must either give up analogy, our safest guide, in such reasoning, or admit the gradual extinction of light in its passage through space, with its millions of meteor streams cutting the ecliptic at all angles, its thousands of comets, its meteoric dust, its zodiacal light, its solar corona, its material atmosphere, so to speak, occupying not only all the interplanetary space, but more or less to the limit of the sun's attractive force.

"And if we are to take our sun as a type of other suns, and in the mind's eye see all surrounded by such an atmosphere, and people all the interspaces with myriads of myriads of comets—nay more, if we accept the view held to be most probable by many astronomers, that it is by the deposition of this material atmosphere on the sun and planets that they are hourly growing and finding those stores of light and heat by which all things live, it is beyond question that there must have been a time when this material atmosphere was far more dense than it is at the present moment, and that there must be in every direction other suns in all stages of the process from the great nebulosity '*without form and void*,' to the Finished Sun, whatever that may be; or, in other words, amidst the infinitude of such systems with which we are surrounded, there are places where probably a sensible amount of clearing up has taken place within the last 35 years.

"And I think in this view we find a rational explanation of the appearance of new stars in this cluster, more especially since it has been shown by others, as well as myself, that in this region of the heavens about the remarkable star η Argus, strange clearings up, so to speak, or wanings of nebulous light have taken place, and many stars have come to view, with telescopes far inferior to Herschel's.

"And whether we admit this view or not, one thing is absolutely certain. Under such a material atmosphere we live and make our observations, and we are not yet prepared to say with certainty whether there may not be such changes going on in it as will suffice for a full explanation of the appearance of these small stars, if not of the great changes about η Argus."

NOTES

THE omission of a word in a note last week referring to the medals recently granted by foreign Governments to Englishmen, makes this journal appear to hold the opinion that it is to be desired that the British Government should thus signalise *British* work. Such, however, is most emphatically *not* our opinion. What we do hold is that if foreign Governments reward English work, it would be a graceful act for our Government from time to time to reciprocate such acts of international courtesy and good-will by marking in a similar manner its appreciation of *foreign* work.

IN the *Russian Official Gazette* is an announcement that a diploma of honour has been conferred upon Baron Liebig for the application of his knowledge of theoretical chemistry to practical purposes.

THE morning of Saturday the 21st has been fixed for the final despatch of H.M.S. *Challenger* on her long voyage. Her scientific staff—officers and civilians—are all on board, and the ship is busy from end to end, stowing and arranging her unwonted gear. As might be supposed, every available space is filled with books. Mr. Macmillan has received the thanks of the captain and officers and the civilian scientific staff, through Dr. Wyville Thomson, for a case of about fifty volumes of his newest publications, which he sent down as a parting gift.

PROF. HUXLEY has been elected Lord Rector of the University of Aberdeen, by a considerable majority over the Marquis of Huntly, a satisfactory evidence of the estimation in which eminence in science is held by the younger minds in Scotland.

WE regret to learn that M. Pouchet, of Rouen, celebrated as a leading champion of the doctrine of spontaneous generation, died in Paris on December 6.

THE following are the probable arrangements for the Friday evening meetings at the Royal Institution before Easter, 1873:—Jan. 17, On the Old and New Laboratories at the Royal Institution, by W. Spottiswoode, F.R.S.; Jan. 24, On the Analogies of Physical and Moral Science, by Rev. Prof. T. R. Birks; Jan 31, On the Music of the Future, by E. Dannreuther; Feb. 7, On Old Continents, by Prof. A. C. Ramsay, F.R.S.; Feb. 14, On Recent Progress in Weather Knowledge, by R. H. Scott, F.R.S.; Feb. 21, On Action at a Distance, by Prof. J. Clerk Maxwell, F.R.S.; Feb. 28, On Livingstone's Explorations in Africa, by Sir H. C. Rawlinson, F.R.S.; March 7, On the Temperature of the Sun and the Work of Sunlight, by J. Dewar; March 14, On Steamers for Channel Communication, by E. J. Reed; March 21, On New Alcohols from Flint, by J. Emerson Reynolds; March 28, On the Meaning of Force and Energy, by Prof. W. K. Clifford; April 4, Prof. Tyndall, F.R.S.

NATURAL Science at Rugby is producing its fruits. In the recent examination for honours at Oxford, six men were placed in the first class; and of these, four were educated at Rugby—Messrs. Baynes, Cleminshaw, Longstaff, and Lupton.

DR. HARRY RAINY, Emeritus Professor of Forensic Medicine in the University of Glasgow, has given a donation of 1,500*l.* to the University for the endowment of bursaries, to be competed for by students of Medicine.

DR. JOHN STENHOUSE is at present investigating the higher iodo-derivatives of the orcines.

THE Riberi triennial prize of 20,000 lire (800*l.*) has been awarded to Dr. Guiseppe Corradi, director of the surgical clinic at Florence, for four works on the diseases of genito-urinary organs.

AT the second meeting of the North British Branch of the Pharmaceutical Society of Great Britain Prof. Crum Brown gave an address on the relation of the science of chemistry to the art of pharmacy. He afterwards sketched the career of Scheele, the Swedish chemist and druggist, who had contributed a large list of facts to science.

PROF. FREIRE-MARRECO of Newcastle, and Mr. G. A. Lebour will lecture on January 8, and February 5, 1873, at the Rothbury Reading Room, on Artificial Lighting and on Caverns.

A VERY important paper has been printed by Government, respecting the *Phylloxera vastatrix*, or new Vine Scourge. It commences with a letter from Sir C. Murray, H.M. Ambassador at Lisbon, calling attention to the ravages of the disease; and stating that the Portuguese Government has named a Commission "to examine into the progress of this dangerous evil, and to gather from all quarters, whether scientific or practical (*sic*) suggestions for the best mode of extirpating it." A report follows from Mr. Crawford, H.M. Consul at Oporto, on the scientific aspects of the disease, as well as several others from French authorities, including a very important one addressed to the Minister of Agriculture and Commerce by the Commission instituted for the study of the new disease, M. Dumas, president. The various papers having been referred to Dr. Hooker for him to report upon them, he states that the only really effectual remedy at present discovered, and this can obviously be only very partially applied, and not in the best districts, is flooding the vineyards in winter. He adds "there is reason to believe that on the first symptoms of attack in isolated cases, the prompt destruction of the vine, its burning on the spot, and the subsequent treatment of the soil with some approved insecticide, such as carbolic acid, would be of great importance." Vines of American species appear at present to have enjoyed immunity from its ravages in the Rhone district, but the disease has undoubtedly appeared in this country on vines cultivated under glass.

THE South London Entomological Society, which, though only nine months old, has been extremely successful, held on Thursday evening last, at Dunn's Institute, Newington Causeway, a very interesting exhibition of collections of insects, chiefly British Lepidoptera. The collections were made by the members themselves, all amateurs, and do them the greatest credit. The room was densely crowded, and the exhibition was a great success.

A SOCIETY has been formed under the title of the National Health Society, which is to have for its object to help every man and woman, rich and poor, to know for himself, and to carry out practically around him, the best conditions of healthy living. The steps at present proposed are the holding of monthly meetings for the reading of papers; the establishing of classes for instruction in various branches of sanitary science; the delivery of free popular lectures; and the formation of a reference library and an information office.

A VIGOROUS attempt is being made to establish a Museum, principally in connection with Geology, Mineralogy, and Natural History, at the Giggleswick Grammar School, under the management of Mr. Style. The Settle Cave Exploration Committee have sent for the Museum the collection of fossils and other remains obtained from the Victoria Cave. The collection is of great and increasing scientific value, for the exploration of the cave is still going on under the auspices of the Local Committee and of the British Association for the Advancement of Science.

IN inserting in last week's *Les Mondes* a long and deservedly laudatory article from *Le Français*, on himself and his recently-started "Salle des Progrès," l'Abbé Moigno expresses a fear that he may be compelled to give up the project on which he has so enthusiastically entered, from want of means. We sincerely hope this may not be the sad end of the noble effort made by the Abbé to benefit his fellow-citizens.

THE following is from the *Times*:—"A despatch from Detroit, Michigan, states that on the night of November 25, Prof. Watson, of the Ann Arbor Observatory, discovered a new planet in the constellation Taurus. Its R A. is 65° 25′; D. 19° 34′ N. It shines like a star of the tenth magnitude. Its motion is nearly parallel with the equator."

PROF. PETERS has named the two planets lately discovered by him (Nos. 122 and 123) Gerda and Brunhilda, and communicates to the *American Journal of Science* the elements of their orbits. The orbit of Gerda is remarkable for having both the inclination and eccentricity very small—a coincidence not found in any other known asteroids except in the case of Clytia. The planet No. 124 is now known as Aleste, and at the time of Prof. Peters's communication had the appearance of a star of a little less than the eleventh magnitude.

THE Naples correspondent of the *Times* states that for some time previous to her death Mrs. Somerville was engaged in writing her own life.

WE learn from the *School Board Chronicle* that the Netherlands Association for the promotion of labour and industry has awarded a gold medal to Madame Elise van Calcar, a well-known Dutch authoress, for her solution of the following prize question.—"How should girls be taught and educated so as to enable unmarried women to earn an independent livelihood, and the married to bring prosperity and happiness to their respective families?"

THE *Garden* says that the Royal Botanical Society of Belgium and the Botanical Society of France have just decided to make in common a scientific excursion next spring in the valleys of the Meuse and Scheldt.

THE *British Medical Journal* says a project is on foot to resume the publication of an Hospital gazette in Dublin, containing only original scientific matter. It would be published twice a month, would consist of sixteen pages only, and would be issued at an annual subscription of half-a-guinea.

THE existence of such a Society as the New Zealand Institute reflects the highest credit on our antipodal fellow-subjects, who, in their hard fight to make a home for themselves on the other side of the world, do not neglect the means of furthering their highest interests. The institution is a Government one, and was established under the provisions of the New Zealand Institute Act, 1867, of the General Assembly of that colony. It is the *alma mater* of all the societies in the colony that are devoted to the promotion of "science, literature, or art." These societies are incorporated or affiliated with it, and include the Otago Institute, the Philosophical Institute of Canterbury, the Auckland Institute, the Wellington Philosophical Society, and the Nelson Association for the Promotion of Science and Industry, representing all the leading provinces of New Zealand. The ordinary membership amounts to 600, and includes all the leading colonists residing in different parts of the several provinces. The Institute possesses a museum, laboratory, and library, which, with the work therein, are so organised and utilised for the benefit of the general public that they constitute in combination an important "Technical College," located at Wellington—a formidable, but, we hope, friendly rival to the recently established "University of Otago," which aims at becoming, among other things, an eminent school of applied science. The college is also the head-quarters of the Government Geological Survey, the chief members of the staff of which are professors to the Technical College, the lectures being of two kinds, general and practical. The former include natural history (zoology and botany, with their relations to physical geography and geology) and the elements of experimental science (physics, chemistry, and mineralogy). The practical is, in the meantime, confined to mineralogy and chemistry. Since the New Zealand Institute was established, in 1867, it has published no less than four bulky annual volumes, containing papers mostly of a scientific kind, many of which contain substantial contributions to science. All this promises well for the future welfare of the colony.

WE have received part I of vol. ii. of the "Transactions of the Edinburgh Geological Society," embracing the period between November 1869 and April 1872. It contains a number of very interesting and valuable papers on the geology of various districts of Scotland, including one by Sir Roderick I. Murchison, on the structure of the North-West Highlands, said to be the last geological paper written by Sir Roderick.

M. COLLAS, of Paris, comments in *Les Mondes* of December 12, on M. A. Lallemande's paper on the blue colour of the atmosphere, in which it was attributed to a change of refrangibility due to a partial absorption of the chemical or ultra-violet rays. In 1870 M. Collas, in an article in *Les Mondes*, attributed the blue colour of the Lake of Geneva and other waters to the quantity of silex held in solution, which is brought down by the tributary streams from the strata through which they pass. Numerous observations since have induced him to believe that the blue colour of all the water of the globe is due to the same cause. The air everywhere always contains more or less of moisture due to evaporation from the water of the earth, the water thus evaporated always contains a greater or less quantity of extremely fine insoluble particles. Silex, says M. Collas, is one of the most common insoluble substances in nature, and through evaporation, performs the same function in the blue sky that he believes it does in the blue waters of the earth. He believes his theory is confirmed by the intense blue of southern skies, where evaporation is so much greater than in the colder north.

THE question has often been debated whether flies eat the pollen of plants, or merely carry it away accidentally on their legs and backs. The question would appear to be set at rest by a paper read at the last meeting of the Scientific Committee of the Royal Horticultural Society by Mr. A. W. Bennett, in which it is stated, as the result both of his own observations and of those of Erm. Müller, that the microscopic examination of the stomachs of Diptera belonging to the order Syrphidæ, shows them to contain large quantities of pollen-grains, especially of plants belonging to the order Compositæ. Entomologists had expressed a doubt as to whether it were possible for insects possessed only of a suctorial proboscis to devour such solid bodies as pollen-grains; but Müller believes that the transverse denticulations found in the valves at the end of the proboscis of many Diptera are especially adapted for chewing the pollen-grains, and for dividing the threads by which the grains are often bound together.

MR. FRANK BUCKLAND, writing to the *Times*, announces the birth in London, of a young rhinoceros (*R. sumatrensis*). The event took place at the Victoria Docks, on board the ship in which the mother had just arrived from Singapore; she, along with a male, having been captured by the natives of Malacca; the latter, however, died during the voyage. The young thing has been removed to the house of Mr. Rice, one of the owners of it and its mother, and we believe is getting along famously. We hope the "cockney rhinoceros," as Mr. Buckland calls it, may thrive as well as the young hippopotamus in Regent's Park, and not be permitted to cross the Atlantic, as, it seems, there is some danger of its doing, unless the Zoological Society secure it and its mother for their collection.

THE number of candidates for the ensuing matriculation examination of the University of Madras is 1,565, and the number of candidates for the first arts examination, 242.

JUDGING by the prospectuses which have fallen into our hands we cannot help concluding that the ladies of Glasgow are being well provided for in the way of lectures in the ensuing winter. No fewer than four courses are announced for their behoof. First, we have Dr. John Young, the Professor of Natural History in the University of Glasgow, with a course of sixteen lectures on his own special subject, and by means of which he proposes to give his auditors a comprehensive account of the animal kingdom, by selecting and dilating upon special and judiciously chosen types of animal structure, and their position in geological time. Next comes Mr. Edward Caird, the Professor of Moral Philosophy, with the same length of course, on the History of England, the range to be considered extending from the first period of English History to the time of Edward I., when the settlement of the principles of the Constitution was effected. This course will be open to gentlemen as well as ladies. A third University course of sixteen lectures is also announced, and will be open to gentlemen only, the lecturer being Mr. John Ferguson, M.A., Assistant to the Professor of Chemistry. These will be evening lectures, and, of course, the subject will be Elementary Chemistry. The Professors of Chemistry and Natural Philosophy in Anderson's University, apparently by way of supplementing the courses of biological and historical lectures of Profs. Young and Caird, have each commenced a course of twelve lectures for ladies, to be delivered in the Corporation Galleries, Dr. Thorpe taking Elementary Chemistry, and Prof. Forbes making Heat his special subject. These four courses of lectures for ladies will all be given at the same hour, but on different days, so that very zealous lady students may attend them all.

A CERTAIN Dr. A. Wolfert publishes an extraordinary article "in *Petermann's Mittheilungen*, Das Nordlicht eine weder magnetische noch electrische Erscheimung." The aurora, it appears, is neither electrical nor magnetic, but is the result of the reflection and refraction through the earth's atmosphere of the sun's rays remaining over from the summer!

AT the first ordinary meeting of the Pathological Society of Dublin, for the present session, held on Nov. 30, the President, Dr. George H. Kidd, announced that the subject chosen by the Council for competition for the gold medal, to be awarded to the best essayist in 1873, was "The Diagnosis and Pathology of Abdominal Tumours."

SCIENTIFIC SERIALS

THE *Geological Magazine* for November (No. 101) commences with a note on the forms of valleys and lake-basins in Norway by Mr. J. M. Wilson, in which the author draws attention to a connection which he has observed between the configuration of the surface of the country and the disposition of the principal planes of division of the rocks, this disposition apparently altering with the windings of the valleys. His notion appears to be that masses of rock have been torn away by glacier action until a divisional plane offering a minimum resistance to the passage of the ice was exposed.—The second article is the conclusion of Mr. Alfred Tylor's paper on the formation of deltas and on the evidence and cause of great changes in the sea-level during the glacial period, in which the author describes at considerable length the structure of the Delta of the Po (which is illustrated by sections of numerous artesian borings in Venice), and refers also to those of the Mississippi, Ganges, and Volga, in support of his views as to the peculiar curves formed by the surface of these deposits, his hypothesis of the former occurrence of a general "Pluvial" period, and his belief that during the glacial period there was an actual subsidence of the sea, due partly to its contraction by cold and partly to the abstraction of large quantities of water to form the enormous deposits of ice and snow in the colder regions. He also indicates the curves produced generally by denudation and deposition.—Mr. John Hopkinson describes some new species of Graptolites from the South of Scotland, including representatives of the genera *Dendrograptus*, *Graptolithus*, *Diplograptus*, and *Dicranograptus* from the Llandeilo rocks of Lanarkshire and Dumfriesshire; and a species of the anomalous genus *Corynoides* from the latter district. This paper is illustrated with a plate.—From Prof. Hall, of Albany, we have a note on the relations of the Middle and Upper Silurian (Clinton, Niagara, and Helderberg) rocks of the United States, written in opposition to Mr. A. H. Worthen, and in support of the generally received opinions upon this subject. The paper, although to a certain extent controversial, furnishes a useful summary of this department of American geology.—Mr. H. B. Woodward publishes a note on the Midford Sands, which he seems inclined to regard as truly transitional between the Upper Lias and the Inferior Oolite, and from this takes occasion to hint that the Keuper, Lias, and Oolites may be looked upon as one conformable series, the divisions or stages of which are to a certain extent arbitrary. The number concludes with the completion of Prof. Nordenskiöld's account of his expedition to Greenland in 1870.

Poggendorff's Annalen der Physik und Chemie, No. 9, 1872, contains two mineralogical papers, one by Vom Rath, on Anorthite, being a crystallographic study of the Naples collection; and the other by Dr. Lasaulx on Micromineralogy (second of a series), and treating of the metamorphic phenomena in protogine, granite, &c.—W. Stille discusses mathematically the theory of the boomerang's motion; and a paper by F. Braun treats of the influence of rigidity, fixture, and amplitude on the vibrations of strings; figures being given, showing the traces made by a feather (attached to the string), on a smoke-blackened cylinder, under varying conditions of the kind mentioned. F. B. Hofmann describes the spectral phenomena of phosphuretted hydrogen and of ammonia, and his paper is connected with one by F. Hoppe-Seyler on the production of light by atomic motions. Two of the Royal Society's papers, and one or two articles on chemical subjects make up the rest of this number.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 12.—"On the Structural Composition of Urinary Calculi." By H. Vandyke Carter, M.D.

"A Contribution to the Knowledge of Hæmoglobin." By E. Ray Lankester. According to the author the distribution of hæmoglobin may be summarised as follows:—

1. In special corpuscles.
   a. In the blood of all vertebrates, excepting *Leptocephalus* and *Amphioxus* (?).
   b. In the perivisceral fluid of some species of *Glycera*, of *Capitella*, and *Phoronis*.
   c. In the blood of *Solen legumen*.
2. Diffused in a vascular or ambient liquid.
   a. In the peculiar vascular system of the Chætopodous

Annelids very generally, but with apparently arbitrary exceptions.

b. In the vascular system of certain Leeches, but not of all (*Nephelis*, *Hirudo*).

c. In the vascular system of certain Turbellarians as an exception (*Polia*).

d. In a special vascular system (distinct from the general blood-system) of a marine parasitic Crustacean (undescribed), observed by Prof. Edouard Van Beneden.

e. In the general blood-system of the larva of the Dipterous insect, *Chironomus*.

f. In the general blood-system of the pulmonate mollusc, *Planorbis*.

g. In the general blood-system of the Crustaceans, *Daphnia* and *Cheirocephalus*.

3. Diffused in the substance of muscular tissue.

a. In the voluntary muscles generally of Mammalia, and probably of birds, and in some muscles of reptiles.

b. In the muscles of the dorsal fin of the fish *Hippocampus*, being generally absent from the voluntary muscular tissue of fish.

c. In the muscular tissue of the heart of Vertebrata generally.

d. In the unstriped muscular tissue of the rectum of man, being absent from the unstriped muscular tissue of the alimentary canal generally.

e. In the muscles of the pharynx and odontophor of Gasteropodous Molluscs (observed in *Lymnæus*, *Paludina*, *Littorina*, *Patella*, *Chiton*, *Aplysia*), and of the pharyngeal gizzard of *Aplysia*, being entirely absent from the rest of the muscular and other tissues, and the blood of these Molluscs, with the single exception of *Planorbis*, cited above (2 *f*).

f. In the muscular tissue of the great pharyngeal tube of *Aphrodite aculeata*, being absent from the muscular tissue and from the blood in this animal, and absent from the muscular tissue generally in other animals.

4. *Diffused in the substance of nervous tissue.*

a. In the chain of nerve-ganglia of *Aphrodite aculeata*.

Zoological Society, Dec. 3.—Viscount Walden, F.R.S., president, in the chair. The secretary read a report on the additions that had been made to the Society's collection during the months of October and November, amongst which were particularly noticed a Nippon Ibis (*Ibis nippon*), and other birds, presented by R. Swinhoe, H.B.M. Consul at Ningpo, China.—Mr. P. L. Sclater exhibited a nest of the Tigereta (*Milvulus tyrannus*), containing one egg of that bird and nine of the parasitic *Molothrus bonariensis*, which had been sent to him by Mr. W. H. Hudson, of Buenos Ayres.—Mr. H. E. Dresser exhibited a series of skins of eagles of Europe and India. After a careful investigation Mr. Dresser had come to the conclusion that three good species had hitherto been included under the name of the Imperial Eagle, four under that of the Spotted Eagle, and two under the name of the Tawny Eagle. Mr. Dresser pointed out the various plumages and localities of these species.—Prof. Owen, F.R.S., read a paper on the osteology of the Marsupialia, being the fourth of his series of papers on this subject. The present communication contained a description of the trunk and limbs of the Wombats (*Phascolomys*).—A communication was read from Mr. R. B. Sharpe, entitled "Contributions to the Ornithology of Madagascar."—A communication was read from Dr. J. E. Gray, F.R.S., on the Fossane of Madagascar (*Fossa d'Aubentonii*), of which animal the British Museum had recently received specimens.—A second communication from Dr. Gray contained notes of a Terrapin from British Columbia, which had been presented to the British Museum by J. K. Lord, as the *Actinemys marmorata* of Agassiz.—A communication was read from Sir Victor Brooke, Bart., giving the description of a new species of antelope from the river Gambia, living in the Society's menagerie, which he proposed to call *Nanotragus nigri-caudatus*.—A communication was read from Dr. A. Günther, containing notes on a hitherto unpublished drawing in the Buchanan-Hamilton collection, representing *Barbus beavani*. Three short communications were read from Mr. Andrew Garrett, of Tahiti, in which he gave descriptions of two new species of *Separatista*, two new species of *Caecum* from the Viti Islands, and a new species of *Scissurella* from the Panmotu Islands.

Geological Society, Dec. 4.—Prof. P. Martin Duncan, F.R.S., V.P., in the chair. "On the Tremadoc Rocks in the Neighbourhood of St. David's, South Wales." By Henry Hicks. The author stated that Tremadoc rocks occur in three distinct places near St. David's—namely, in Ramsey Island, at the north end of Whitesand Bay, and over a considerable tract of country about five miles east of St. David's. They rest conformably on the Lingula flags, and are about 1,000 feet thick in Ramsey Island. The author noticed the fossils found in these deposits, nearly all of which are of new species, and stated that the palæontological evidence proves these rocks to be nearly allied to, if not identical with, the lower part of the Tremadoc rocks of North Wales. The Upper Tremadoc rocks of North Wales seem to be represented at St. David's by the so-called Arenig rocks which overlie the deposits described in the present paper.—"On the Phosphatic Nodules of the Cretaceous Rock of Cambridgeshire." By the Rev. O. Fisher. The author stated that this paper was founded upon one read by him before the Society in May last, but subsequently withdrawn, in consequence of his obtaining information which necessitated a change of opinion upon certain points. The new portion related chiefly to those nodules which had been regarded as belonging to *Porospongia* or *Scyphia*, the fenestrated structure shown in sections of which the author now identified with the structure of *Ventriculites*, as described by Mr. Toulmin Smith, the whole arrangement, and especially the presence of an octahedral figure at the nodes where the fibres of the framework intersect one another, being in favour of this determination. The author described the peculiarities of these octahedra, and dwelt particularly upon the fact that these sections of phosphatic nodules showed clearly that the fibres are really tubular, and not, as Toulmin Smith supposed, solid.—"On the Ventriculitidæ of the Cambridge Upper Greensand." By W. Johnson Sollas. A collection of supposed sponges found in the Cambridge Upper Greensand had been in part referred to the genera *Scyphia* and *Porospongia*, and in part left unidentified. An examination of sections of these forms by the microscope had revealed all the details of Ventriculite structure; and a careful comparison with Mr. Toulmin Smith's descriptions and specimens had resulted in the identification of those examined with four of Mr. Smith's species; thus *Scyphia tessellata* was shown to be equivalent to *Ventriculites tessellatus* (or, more correctly, *V. texturatus*), *Porospongia ocellata* to *V. cavatus*, and other unnamed forms to *V. quincuncialis* and *V. mammillaris* respectively. The occurrence of ventriculite-structure in coprolitic material presents a favourable opportunity for a fresh inquiry into its nature; accordingly the author described the minute characters of the hexradiate elements of which the skeleton is composed, and the combinations of these hexradiates with one another. Abnormalities occur sometimes by the hexradiates becoming heptoradiate or pentaradiate, and sometimes by some of their rays bending quite away from their normal course. The whole of the skeleton fibre is distinctly tubular. Since the Ventriculite fibres have now been found fossilised in chalk, flint, and calcic phosphate, there can be little doubt that they were keratose, and not siliceous in their nature. If this be so, we have a difference between Nitrea and Ventriculitidæ of ordinal value at least, and we must look for allies to the Ventriculites among the horny sponges. *Verongia* resembles Ventriculites in the single hollow cavity of its fibre and the non-spiculate character of its skeleton; *Darwinella* offers a resemblance in its hexradiate horny spicules, and *Spongionella* in the regular arrangement of its fibres. These three genera are indices of the directions in which the Keratosa tended to vary. At a very early period great variation occurred among the Keratosa, which already, at the time of the Weisse Jura, had evolved such highly symmetrical specialised forms as the Ventriculites; these, with their contemporary variations, such as Verongioid forms, lived on in great numbers throughout the Mesozoic period, with the close of which the Ventriculites altogether disappeared; and their nearest allies dwindled down to the dwarfed and rare genera *Verongia*, *Darwinella*, and *Spongionella*.

Chemical Society, Dec. 5.—Dr. Frankland, F.R.S., &c. president, in the chair. The first two papers read were "On Hypophosphites" and "On the reducing power of Phosphorous and Hypophosphorous Acid and their Salts" by Prof. C. Rammelsberg.—A communication by Prof. A. H. Church, entitled "New Analyses of certain numeral Arseniates and Phosphates" followed, giving his results of the examination of the minerals, Fluorapatite, Arseniosiderite, Childerite, Uhlite, Tyrolite, and Wavellite.—"On the condition of hydrogen occluded by palladium as indicated by specific heat of the charged metal" by W. C. Roberts and C. R. A. Wright, D.Sc. This interesting compound, which was discovered by the late Prof. Graham, Master of the Royal Mint, and supposed by him to be an alloy of palladium and hydrogen, is obtained on making metallic palladium, the negative pole in the electrolysis of water aciduated with sulphuric acid. The authors find, however, that the charged metal cannot be regarded as a true alloy of the two elements.

Anthropological Institute, Dec. 3.—Sir John Lubbock, Bart., F.R.S., president, in the chair.—Col. A. Lane Fox exhibited seven celts presented to him by Col. Pearce, R.A., who procured them from the grove and hill-top Temples of the Malayalis or hill-tribes of the Shevavoy hills, Salem, Madras Presidency. Col. Fox also read a report on Anthropology, at the meeting of the British Association at Brighton.—Professor T. Rupert Jones, F.R.S., read a paper "On Implements from the Caves of Périgord, France, bearing marks referable to ownership, tallying, gambling, &c." Among the implements of bone, deer-horn, and ivory found by MM. Christy and Lartet in the caves of the Dordogne district in France, are many bearing more or less definitely designed marks, such as scorings and notches, parallel, crossing, or otherwise arranged, and fittings in a roughly quincuncial order. One specimen in particular exhibited several of these kinds of markings, whether made for a purpose, for ornament, or by trivial whittling. Prof. Jones described several implements from the caves exhibiting one or more of these types of marks, and indicated their applicability to ownership, reckoning by tally, gambling, or mere fancy-work; he also suggested that therein we might have some of the earliest examples of magic signs and lucky charms, such as the old Norsemen and some Archaic people are said to have used and feared. Lieut. C. Cooper King, R.M.A., read a paper "On a Flint Implement Station at Wishmoor Bottom, Bagshot Heath." The interest of the discovery of flint chips and implements between Bagshot and Sandhurst lay chiefly in the peculiar nature of the locality in which these ancient traces of early human life were found. Apparently from the topography of the ground they had occupied the bed of a swampy valley which it was suggested had been, at the time of the deposition of the relics, a small lake area, near one of the great Western routes. It was further pointed out by the author that the flints themselves appeared not to be of local origin. and that the work performed at the place of discovery had probably been that of re-fashioning existing implements, rather than the construction of new ones from local flints.

MANCHESTER

Literary and Philosophical Society, Oct. 29.—Edward Schunck, F.R.S., vice-president, in the chair. Dr. R. Angus Smith, F.R.S., described a remarkable fog which he saw in Iceland. It appeared to rise from a small lake and from the sea at about the same time, when it rolled from both places and the two streams met in the town of Reykjavik. It had the appearance of dust, and was called dust by some persons there at first sight. This arose from the great size of the particles of which it was composed. They were believed to be from $\frac{1}{400}$th to $\frac{1}{500}$th of an inch in diameter. They did not show any signs ot being vesicular, but through a small magnifier looked like transparent concrete globules of water. They were continually tending downwards, and their place was supplied by others that rolled over.

Nov. 12.—J. P. Joule, F.R.S., president, in the chair. Additional Notes on the Drift Deposits near Manchester, by E. W. Binney. F.R.S. An Account of some Experiments on the Melting Point of Paraffin, by Balfour Stewart, F.R.S.

Nov. 26.—J. P. Joule, F.R.S., president, in the chair. Dr. R. Angus Smith, F.R.S., said that he, like others, had observed that the particles of stone most liable to be in long contact with rain from town atmospheres, in England at least, were most subject to decay. Believing the acid to be the cause, he supposed that the endurance of a siliceous stone might be somewhat measured by measuring its resistance to acids. He proposed therefore to use stronger solutions, and thus to approach to the action of long periods of time. He tried a few specimens in this way, and with most promising results. Pieces of about an inch cube were broken by the fall of a hammer, and the number of blows counted. Similar pieces were steeped in weak acid; both sulphuric and muriatic were tried, and the latter preferred. The number of blows now necessary was counted. Some sandstones gave way at once and crumbled into sand, some resisted long. Some very dense siliceous stone was little affected; it had stood on a bridge unaltered for centuries, in a country place however. These trials were mere beginnings; he arranged for a very extensive set of experiments to be made so as to fix on a standard of comparison, but has not found time.—"On some points in the Chemistry of Acid Manufacture," by H. A. Smith, F.C.S.

NEW ZEALAND

Wellington Philosophical Society, July to September.—Weekly meetings have been held during the session, which was commenced by an address of the President, Dr. Hector, concerning certain matters that have been under discussion. Relative to the extinction of the Moa, he considers that there is evidence that they existed in Otago in considerable numbers within 200 years, and that a few may have survived to within seventy years. Referring to the first period in which Moas first appeared, he points out the absence of any evidence of there having been a Glacial period in the New Zealand area, there being no dispersed drifts. Nor is there any evidence of submergence since the last great extension of the glaciers which were coincident with a much greater elevation of the central ranges of the South Island than at present. Important contributions have also been made to the natural history of lizards, birds, and fishes of the colony by Dr. Butler, Captain Hutton, Mr. Travers, and others.—A series of papers is in progress by W. T. L. Travers, describing the changes effected in the Maories at the time they first acquired fire-arms and European implements, and when there was a sudden stride of a powerful race from the age of stone to that of iron.—An important paper by Captain Hutton on the geographical relations of the New Zealand fauna, in which he argues:—(1) A continental period in which South America, New Zealand, Australia, and South Africa were joined, which he places about the close of the Mesozoic. New Zealand was then separated, prior to the spread of mammals, and has since then never been completely submerged. (2) Subsidence followed, and a second continent connected, New Zealand, Lord Howe's Islands, New Caledonia, and Polynesia. (3) Subsidence then reduced New Zealand to a group of Islands, upon which the Moa lived, so that many species arose (4) Re-elevation joined the small Islands and mixed the different species of Moa which inhabited a large Island disconnected from Polynesia. (5) This was followed by subsidence, when New Zealand acquired its present form, and the Moas continued till they were destroyed by the Maories.

Sept. 17.—Captain Hutton read an elaborate paper on the date of the last great glacier period in New Zealand, and the formation of the Wakatipu Lake. The author, in opposition to the views expressed by Dr. Hector and to those held also by Dr. Haast, attributes the formation of the terraces that are so common in the valleys in the South Island to marine action, advancing the view that New Zealand has been submerged beneath the sea, since the valleys were eroded by glaciers the former extension of which he attributes solely to extreme elevation of the land during a preceding period, considering the view expressed by Dr. Hector that there has been a reduction of the area of land above the snow line by the erosive action of the glaciers as unnecessary and exaggerated. Speaking of the Canterbury plains, the author stated that Dr. Haast's sections show that they are nearly level in a line parallel with the coast between the Rangitata and the Waimakiriri, and that the gravel formation wraps round the spurs of the hills at the same level that it has at the river gorges, and considers that these facts and also the occurrence of vegetable deposits below the gravel of the plains, are readily explained by supposing these to be of marine formation, and quite inexplicable on the river formation theory. Another proof of recent elevation is the fact that the glaciers are now advancing and overriding their terminal moraines. The absence of striæ on the rock surfaces the author considers to be a strong proof that the glaciers were extended during the Pliocene, and not a more recent period. The origin of deep lakes, taking Wakitipu as a type, and the sounds on the West Coast were next described with the view of proving that their formation is not due to subsidence or unequal depression, but only to the scooping out of the rock by glaciers. Dr. Hector could not agree with the conclusions arrived at further than attributing the erosion of the Alpine valleys and the rock-bound lake basins to the scooping of ice. On the whole, he thought, no proof had been advanced of any Pleistocene submergence beneath the sea of the Alpine district since the excavation of the great valleys by the glaciers. After quoting Sir Charles Lyell, who points out that the time required for similar excavations is so extensive that it covers a period during which we know that great oscillations have taken place, Dr. Hector drew attention to the irregularity in the movement of the land during the earthquakes of 1848 and 1855, which amounted to 9 ft. elevation at Palliser Bay and was not perceptible at Porirua, while there is good reason to believe that in Blind Bay there was a marked depression. The elevation of the Bally Rock in this harbour, and the depression of the Hapuku Rock at the Astrolabe since the publication of the Admiralty Charts, was also advanced as evidence that unequal movements have taken place on a small scale, and of course such may be cumulative throughout long periods.

Sept. 25.—Referring to the skeletons of the huia which were exhibited, Dr. Hector pointed out that the great difference in the length of the beaks in the male and female huias is due only to the prolongation of the horny mandible of the latter, the jaw bones being the same size in both sexes. This is not like the kiwi, in which the apparent excess in the length of the beak in the female is really produced by the lengthened bones of the face. Anatomically, the kiwi has the shortest beak of any known bird of its size. The strong mucular crest on the skull of the male huia at once distinguishes it, however, and supports the view that the male beak is used as an adze, and the female as a probe.

PARIS

Academy of Sciences, Dec. 9.—M. Faye, president, in the chair.—MM. Littré and C. Robin presented their Medical Dictionary to the Academy together with a short descriptive note.—M. de Saint-Venant read the second portion of his paper on the division of the force of a vibratory movement into those due to simple oscillatory movements of various periods and amplitudes.—M. Jamin read a note on the distribution of Magnetism. This was a criticism on M. Treve's paper on this subject, read at the last meeting. The author disagrees with his statement that the poles of a magnet are displaced when an armature is applied.—M. Pasteur promised on a future occasion to reply to the observations of MM. Béchamp and Estor, made at the last sitting.—M. Claude Bernard then answered M. Bouillaud's criticism on his late paper on animal heat: he defends the generally received theory that animal heat is produced in the capillaries; he denied that he stated it to be produced in the liver; and argued against Lavoisier's old theory that it arose solely in the lungs. M. Bouilland replied, and defended Lavoisier's theory, which he considers to be proved beyond doubt. M. Milne-Edwards then spoke on the subject: he alluded to the experiments of his brother, William M. Edwards, which proved that carbonic anhydride continued to be evolved from the lungs of an animal when it was deprived of oxygen, thus showing that the former gas was brought by the blood into the lungs, and not formed in them by the act of inspiration. A letter from Father Secchi, dated Rome, November 22, was then read. It related to the solar spots and diameter: he has observed the diameter on the lines *B* and *C*, and finds that each gives different results; this he explains thus:—*B* gives the solar diameter without the chromosphere, *C* the diameter plus the chromosphere.—M E. Belgrand read a paper on the floods of the Seine and its affluents; after which MM. Is. Pierre and Ed. Puchot read some observations on several groups of isomeric substances derived from the alcohols of fermentation. The authors draw attention to the remarkable resemblances and differences in certain isomeric bodies, *e.g.* many isomers differing immensely in boiling-point, odour, and density at the boiling-point, have the same density exactly at 0°.—M. Burdin read a paper entitled a "Glance at the immense part played by ether in Nature," a paper relating to the luminiferous ether.—The following gentlemen were then appointed judges of the Montoyon Prize for Medicine and Surgery for 1873:—MM. Cloquet, Nelaton, Cl. Bernard, Bouillaud, Robin, Sédillot, Andral, Larry, Milne-Edwards. The following were appointed to award the Montoyon Statistical Prize:—MM. Ch. Dupin, Mathieu, Boussingault, Morin.—A Report on M. Alph. Milne-Edwards' researches on the anatomy of the semules was then read, and it was decided that the memoir should be inserted among those of foreign *savants*.—Memoirs were received from M. Rosmann on analytical researches on rocks as regards their constituents which are absorbable by vegetables: it was sent to the section of Rural Economy.—On the destruction of the *Phylloxera* from M. Erb, and M. Balissat: sent to the *Phylloxera* Commission.—A note from M. Borrelly giving an account of the discovery and observations of planetoid 128 at Marseilles was then read, and followed by a paper on Geometry of N dimensions by M. Jordan; and by a note from M. Quet on the force of a vibrating system.—M. Sainte-Claire Deville presented a note on the thermic effects of Magnetisation by M. J. Moutier, which was followed by the conclusion of M. Th. du Moncel's paper on the accidental currents which are produced in a telegraphic wire, one end of which remains insulated in the air.—A very short note on electro-magnetism was then received from M. Trèves, and M. Wurtz presented a paper on dibenzyldicarbonic acid by M. Franchimont.—M. H. Byasson's paper on the splitting up of the molecule of chloral-hydrate under the influence of heat and glycerine was then read. At 110° the chloral-hydrate begins to split up into chloroform, hydrochloric acid, and allylic formiate.—M. A. Commaille read a paper on parathionic and thio-amylic acids. These acids, the last of which is isomeric with sulphamylic acid, are found in the mother liquors of coralline.—M. de Quatrefages presented a paper on a new species of chondrostome found in the waters of Rouergne by M. de la Blanchère. The systematic name of the new species is *Chondrostoma Persei*.—A note on the eye of the Germon, by M. Em. Morceau, was then read, and followed by a note on the immediate cause of the variations of the magnetic elements of the earth, by Father Sanna Solaro, who suggests that the ordinary diurnal variations are due to the movement of the sun acting on the statical electricity of the whole mass of the earth and its atmosphere. This movement continually displaces the resultant of the electric actions, and the instruments follow this movement. The perturbations are produced in the same manner.—A note on a Turonian colony in the Senonian stage of Saint Martory (Petites Pyrénées), by M. Leymerie, was then read.—A note on the origin of the planetary week and on Plato's spiral, by M. Sédillot, followed.

BOOKS RECEIVED

ENGLISH.—The Eruption of Vesuvius, 1872; R. Mallet (Asher and Co.).—The Natural History of Plants, vol. 2: H. Baillon (L. Reeve and Co).—Report of the Meteorological Observations in the North-western Provinces of India, 1871: M. Thomson.—Travels in Indu-China and the Chinese Empire: L. de Carné (Chapman and Hall).

FOREIGN.—Memorandum des Travaux de Botanique, 1772-1871; E. Morren (F. Hayez).—Histoire des Sciences et des savants depuis deux siècles: A. de Candolle (H. George).—Zeitschrift fur Biologie Band 8, Heft. 3.—(Through Williams and Norgate).—Das Leben der Erde: Hummel.—Grundrisz der Physik u. Meteorologie: Dr. J. Muller.—Untersuchungen uber das Wesen des Lichts und der Farben: D. Warmann.—Physikalische u. chemische Untersuchungen Ule u. Hummel.

DIARY

THURSDAY, DECEMBER 19.

ROYAL SOCIETY, at 8.30.—Magnetical Observations in the Britannia and Conway Tubular Iron Bridges: Sir G. B. Airy, Pres. R.S.—On the Organisation of the Fossil Plants of the Coal Measures, Part iv.: Prof. W. C Williamson, F.R.S.—Observations on the Temperature of the Arctic Sea in the Neighbourhood of Spitzbergen: Capt. Wells, R.N.

LINNEAN SOCIETY, at 8.—On the General Principles of Plant-construction: Dr. M. T. Masters, F.R.S.

CHEMICAL SOCIETY, at 8.—On the Polymerides of Morphine and their Derivatives: F. Ludwig Major and Dr. C.R.A. Wright.—Analysis of Water of the River Mahanuddy: E. Nicholson.—Communications from the Laboratory of the London Institution: Dr. H. E. Armstrong.—On the Formation of Crystallised Copper Sulphide, &c.: J. L. Davies.

SATURDAY, DECEMBER 28.

ROYAL INSTITUTION, at 3.—On Air and Water: Prof. Odling, F.R.S.

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THURSDAY, DECEMBER 26, 1872

THE PROGRESS OF NATURAL SCIENCE DURING THE LAST TWENTY-FIVE YEARS

I.

ON the occasion of the celebration at Breslau of the twenty-fifth anniversary of Prof. Goeppert's presidency of the Silesian Society for National Culture, Prof. Ferdinand Cohn delivered an address characterised by eloquence of the highest kind on the above subject. As the wanderer, he said, who is climbing towards a high mountain peak, feels from time to time the desire to stand still a little, and look back on the way over which he has passed, to enjoy the wider outlook which he gains from his higher stand-point; so he thinks there are moments in the uninterrupted progress of science, when we long in some measure to strike a balance, and see how much acquired property the present puts aside as useless, how much it uses only for temporary purposes, and how many enduring acquisitions have been made.

Dr. Cohn refers, no doubt with justice and some pardonable pride, to the foremost place held by Germany during the last quarter of a century, in the march of science. At the same time he awards due praise to other European states, and above all to England, which, during that time and more particularly at present, he thinks, abounds in men of the highest eminence, whose scientific achievements stand prominently out on account of their astonishing energy, clearness, depth, and independence of thought. Still, we cannot but admit that Dr. Cohn is right in asserting that Germany is free from the dilettantism which abounds in this country, and that as a rule science in Germany is both far more widespread, and far more thorough than it is among ourselves, and that the opportunities furnished there to all classes for scientific study at the ordinary educational establishments have until recently left us almost nowhere. But happily, signs of the beginning of the end of this state of things among us are becoming rife.

After briefly referring to the intellectual awakening of Germany along with the rest of Europe at the time of the Reformation, and showing how this start forward was, especially in the case of Germany, in a great measure frustrated by the Thirty Years' War, Dr. Cohn pays a high and justly-merited tribute to France, and especially to Paris, on account of the supreme place she took during the first thirty or forty years of the present century in nearly all the sciences. The glory of France in this direction has however, he thinks, departed, and Germany is becoming daily more and more the intellectual centre of the world. Had Dr. Cohn written his lecture now, he might have somewhat modified his language; for within the last few months, the signs have been many, that in the direction of science the French are determined to try to hold their own with the foremost in Europe. Their professors are prosecuting an amount of research which puts our own to shame, while they are at the same time forming a school of investigators. We do not grudge to Germany all the praise she well deserves, and the influence which the results of German research exercise on other nations, is likely to urge them to such vigorous and determined efforts, that, sooner or later, science and every other progressive influence shall be "great gainers." Meantime, however, Germany is doubtless in the ascendant.

In the year 1845 appeared the first volume, and in 1846 the second of Humboldt's *Cosmos*. As comprising a view of the whole created universe depicted with the most wonderful sympathy, the book is as it were a canon forming a key to everything that was known of nature at the time. No man was then more suited for such work than was in the highest degree A. von Humboldt. A *Divina Commedia* of science, the *Cosmos* embraced the whole universe in its two spheres, heaven and earth, Under the leadership of the great searcher of Nature, as Dante once by the hand of Virgil, we climb from the depths of the universe, with its furthest nebulæ and double stars, down through the star depths to which belongs our solar system, to the air and sea-enveloped earth, where form, temperature and magnetic condition are unveiled to us; then to the wealth of organic life, which, stimulated by the light, unfolds itself on its surface. It is an overwhelming picture of nature, of surpassing beauty of outline, abounding in grand perspective, with the most careful execution of the smallest detail.

But we cannot conceal from ourselves that the *Cosmos*, published twenty-five years ago, is in many of its parts now antiquated, not merely because it is wanting in many facts which have since been discovered, but most particularly because Humboldt was ignorant of some highly important questions which have since taken their place in the foreground of scientific discussion, while our scheme of the universe during the last ten years has been considerably modified by the introduction of new and influential ideas. Any one who to-day would attempt to recast the *Cosmos*, must proceed like the Italian architect who took the pillars and blocks of the broken temples of antiquity, added new ones, and rebuilt the whole after a new plan.

There are three discoveries which during the last quarter of a century have entirely changed the position of natural science:—the mechanical equivalent of heat, spectrum analysis, and the Darwinian theories.

Since, in the year 1842, an unknown physician in a Swabian country town, Dr. Mayer of Heilbronn, pointed out that a hammer 424 kilograms in weight, which falls from the height of a metre on an anvil, raises the heat of the latter by one degree centigrade, and that by this process of bringing a falling motion to a stand-still it is converted into a fixed quantity of heat—since then has science gained a new conception of the conditions of matter and of the powers of nature. This new doctrine appears in the mechanical theory of heat announced by Joule, Krönig, Maxwell, and Clausius, in the doctrine of the conservation of energy of Helmholtz and Thomson, and by means of the brilliant writings of Tyndall it has become the common property of the educated world. Electricity and magnetism, heat and light, muscular energy and chemical attraction, motion and mechanical work—all forces in the universe are only different forms of one and the same power, which has dwelt from the first in matter in invariable quantity, neither increased nor diminished. not the least trifle of it can be annihilated or created Only the phenomenal forms of power are changeable;

light can be converted into a chemical equivalent, this again into heat, heat into motion, and indeed a fixed quantity of one force always and only into an equivalent quantity of another. In like manner also the quantity of matter has remained unchanged from the beginning; not the least particle or molecule can be annihilated or created out of nothing, and only in the transformation of perishable bodies are the molecules formed into ever new combinations. What we distinguish as natural forces are only movements of molecules, for the least particles of matter out of which bodies are composed are not inseparably united to each other, but are loosely held together and in continuous whirling and undulatory motion; according to the swiftness and width of undulation of the molecule will this motion of our nerves be regarded now as sound, now as heat, then as light or as colour. Moreover, the chemical union of the elements of matter, the attractive power of gravitation in all the bodies of the universe, are but varied forms of this universal motive force. The unity and permanency of substance with its two attributes, matter and force, and their innumerable modifications, which go to form the bodies of the universe, were in the first instance enunciated as a philosophical maxim by the great thinker Spinoza. Now it is established as a philosophic fact by means of exact measure and weight.

Again, on the inner organisation of the system of the universe has unexampled light been thrown by the wonderful researches which were begun in 1859 by two men, united by the closest bonds of a friendship which bore rich fruit for science. After the light of the sun had, in the third decade of this century, been brought into the service of art by Nièpce and Daguerre, Bunsen and Kirchhoff* compelled it also to render service to chemistry and astronomy. Like those magicians of the legend, who, through the power of their knowledge, compelled the spirits of the elements to disclose their most recondite secrets, the genius of these men compelled the rays of light imprisoned in the spectrum apparatus to make revelation of things in the world of stars which the curiosity of men had deemed for ever inaccessible. Already had Kirchhoff ascertained what terrestrial elements were present in the sun's atmosphere, and what were not; quite recently has it been discovered that there is even present in the sun a substance (*helium*) which hitherto has been unknown on the earth. Moreover also, the inner structure of the sun, the distribution of its incandescent, liquid, and gaseous parts, its luminous and coloured envelope, the nature of its spots and protuberances—all this is no longer a playground for fantastic imaginings, but the subject of exact research. Since the great eclipse of 1868, Lockyer and Janssen, Zöllner, Huggins, and Father Secchi have observed, day after day, storms, whirlwinds, flame-sheaves, outbursts of burning hydrogen to the height of 20,000 miles: thus has been developed an entirely new science—the meteorology of the sun. Moreover, on other obscure regions of the heavens, on the physical and chemical conditions, even on the laws of the movements of the fixed and double stars, on nebulæ and milky ways, on planets and comets, on zodiacal and northern lights, has spectrum analysis thrown its enlightening rays. No less by rigorous mathematical method, through which astronomy, even at an earlier period, had been brought to a certain amount of perfection, has she in the most recent time enjoyed an unexpected triumph, by solving, through the researches of Schiaparelli, the riddle of the comets, in being able to recognise the identity of their nature with that of the swarms of shooting-stars whose remarkable brilliancy long ago made them universally known.

(*To be continued.*)

EXPLORATION OF THE SOUTH POLAR REGIONS

III.

At the conclusion of the last article the drifting seaweed was referred to as an important element in enabling us to ascertain the state of the sea about the Antarctic regions. Let us now see whether the conditions of temperature, so far as they have yet been determined, are in harmony with the ideas already developed. By reducing the ascertained directions for all the months of the year to a mean, there is obtained for the maximum of the temperature a curve which coincides with the intersections of the following meridians and parallels of latitude:—

33°	S. lat. and	33°	E. long.	44°	S. lat. and	65°	E. long
35	„	35	„	46	„	67	„
37	„	40	„	47	„	68	„
38	„	43	„	48	„	70	„
39	„	47	„	49	„	71	„
40	„	50	„	50	„	73	„
41	„	55	„	51	„	73	„
42	„	60	„	52	„	74	„
43	„	63	„	53	„	75	„

A glance at a map shows that this curve leads into the midst of the ice-free field, and is only distorted somewhat from its regular course by Kerguelen Island. This curve can be followed even as far as Macdonald Island, which is of high importance, inasmuch as it can be proved from direct observation that a higher temperature of the water exists in these regions, as Dr. Neumayer himself has witnessed. When he, in December and January, 1856-57, was sailing about 53° S. lat., he proved from hourly observations that there was an influx of a warm current between 62° and 72° E. long.

With respect to the higher temperature in the Pacific Ocean, it suffices to mention the circumstance that there exists on the Falkland and Campbell Islands a richer vegetable and animal life than is the case on other islands in the same latitude of the hemisphere. The unusual mildness of the regions is to be ascribed to the neighbourhood of the Australian continent, as well as to the prevailing west and north-west winds. If, on the other hand, a much poorer flora is found on Kerguelen Island than on the Auckland Islands, and if we should be at first inclined to regard this as evidence against the milder influx of warm currents, it should not be forgotten that Kerguelen does not enjoy the warming influence of a great continent, since it lies in the midst of the Indian Ocean, almost equidistant from the two nearest continents, and more than double the distance of the Auckland Islands from Australia. Both around New Zealand and near Kerguelen and south from Cape Horn, the cachelot (*Physeter macrocephalus*), which, it is known, seeks out the warmer waters, is found in abundance.

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* In connection with this discovery it would have been a graceful act on the part of our author to have referred to the names of Stokes and Stewart.—Ed.

Dr. Neumayer quotes Bellinghausen's valuable journal for March 12, 13, and 14, 1820, from which it appears that at least as far south as 61° S. lat., under the meridian of 73·5° E. long., the sea is free from ice. Besides, it appears from his description that both in the sea and in the sky exists an active animal life, and the coruscation of the sea was observed for the first time by him in high latitudes. The occurrence of this phenomenon proves the existence of a very large quantity of organic remains which have been carried in this direction —a fact which, in conjunction with the other phenomena, Dr. Neumayer thinks has a positively demonstrative force.

After the slight sketch of the general phenomena of ice and currents, and the distribution of the warm districts lying immediately to the north of the south polar regions, it will be of interest to take a glance at the results of the several expeditions, with especial reference to the various meridians. If we understand by these results, in the first place, the greatest latitudes reached, and then the greatest stretches navigated inside the polar circle, we shall find, in reference to the former, the following points:—

Cook	came to	71°	15′	S. lat. in	109°	0′	W.	long. in	Jan. 1774
Wilkes	,,	70	0	,,	103	0	,,	,,	March 1839
Bellinghausen		70	0	,,	93	0	,,	,,	Jan. 1821
Bellinghausen		69	30	,,	77	0	,,	,,	Jan. 1821
Weddell	,,	74	15	,,	34	17	,,	,,	Feb. 1823
Morrell (?)	,,	71	0	,,	50	0	,,	,,	March 1823
Ross	,,	71	30	,,	14	51	,,	,,	March 1843
Ross	,,	78	4	,,	173	0	E.	,,	Feb. 1841
Ross	,,	78	11	,,	161	27	W.	,,	Feb. 1842

The first group of most southerly points refers to the regions west of Graham's Land, which according to Dr. Neumayer's theory, is rendered milder so far as climate is concerned, by one arm of the South American current; the second group contains the results of attempts to the east of Graham's Land, and the third, of the journeys of Ross to Victoria Land. Thus then, where the warm currents run towards the south, it is possible to penetrate farthest, and where also, in the regions around the polar circle the girdle of pack-ice is broken through, an open sea is seen in the high south, such as has been described by Ross and Weddell.

With regard to the regions where it is possible to cruise through great stretches inside the polar circle, we find that the most considerable stretch has been navigated between the meridian 30° W. and 50° E. long., where Bellinghausen, Biscoe, and to some extent also Moore, have shown satisfactorily that the land could nowhere extend much farther north than 70°. Also between 70° and 160° W. long. has a large part of the region inside the polar circle been sailed through, and it may with tolerable confidence be surmised that no land of any extent exists there, and that what land there is can extend northwards only a little beyond 70°. From the researches of Ross we learn that from 160° W. and 160° E. long. to far beyond the 70th parallel of latitude no land of any extent exists, while the Americans inform us of a great continent in the neighbourhood of the polar circle between 155° and 95° E. long. Whether this refers only to several island groups connected by ice, or to an actual coast of great extent, cannot, in the present condition of research, be decided.

The following figures show the mean latitudes reached on the several meridians:—

From	10° W. long.	to	50° E. long.	70° S. lat.	has been reached.
,,	60 E.	,, ,,	90 ,,	63	,,
,,	90	,, ,,	170 ,,	66	,,
,,	170	,, ,,	160 W.	78	,,
,,	160	,, ,,	110 ,,	67	,,
,,	110	,, ,,	50 ,,	70	,,
,,	50	,, ,,	10 ,,	74	,,

According to these numbers, the place where the least advance has been made towards the Pole, between 60° and 90° E. long., is the very part where the condition of the current would prove favourable to a voyage southwards. The question now forces itself upon us, what may be the reason for this, and whether a determined attempt under the meridian of Kerguelen would not lead to the penetration of the polar circle? Leaving out of sight Morrell's doubtful voyages, we see from the following the farthest distance reached at the place in question:—

Bellinghausen's	highest S. lat.	63· °	in March	1820
Biscoe's	,,	62·2	,,	1831
Kemp's	,,	63·5	,,	1833-3
Moore's	,,	64·3	,,	1845

With the exception of Kemp, all these made their way into the region in question in the direction of the parallel of latitude. Other voyagers until late in the season have frequented that part of the Indian Ocean, some even to the end of March. It is therefore evident, from the narratives of these voyagers, that, according to Dr. Neumayer's notion, no attempt has yet been made in the direction most highly favourable.

It should be especially noted here that, south of the 60th parallel of latitude, in the Austral summer, easterly and south-easterly winds prevail, which, towards the end of the season, frequently blow severe storms. It is, therefore, advisable to search the region to be explored from east to west, in order to find out the most direct possible course towards the south, in order to cut through in the shortest possible time the pack-ice, of the position of which in these regions we have got no idea.

Interesting is the course (says Dr. Neumayer) of the two isothermal lines of 0° (the freezing point of the air) for January, February, and for July, August. The isothermal line for the Austral summer assumes the figure of an ellipse, whose smaller axis falls nearly in the direction of the meridian, passing through Graham Land and Sabrina Land from 60° W. to 130° E. long.; the greater axis goes through 20° E., 160° W. long., in the latter case through Victoria Land, which stretches far towards the Pole, and, in the former through a stretch of the Antarctic Sea, which is discovered as far as to 70°, and in which land has been conjectured to exist, but has not been seen, and according to Morrell, will not be found. Does not the bending towards the equator show the completely oceanic character of the greater axis? The limiting bend of this isothermal for the extreme seasons in the direction of the greater axis, and also the greater bend near the small axis, are unfavourable to the assumption of great stretches of land between Enderby and Graham Lands. With this consideration is connected the further question, whether the fact that the bending towards the equator is considerably less in the Pacific than in the Atlantic Ocean is not to be explained by the existence of Victoria Land, to which there is no equivalent on the opposite side. The consequence of such a conclusion would be that Enderby Land and Kemp's Land, in whose neighbourhood it has already been assumed that no considerable land would be found, would be islands, and that between Kemp's Land and Termination Land chances of penetrating towards the south would be greater than under the meridian of New Zealand.

Dr. Neumayer appends the following sketch of the plan upon which he thinks any South Polar expedition should be conducted:—

1. A wooden sailing-vessel with auxiliary screw of at most 300 tons, thoroughly strengthened at the bow and properly arranged on the upper deck, should be sent out on such an expedition. 2. The ship should be equipped with all the most approved appointments and the most recent and best scientific apparatus suitable for the observation of phenomena of all kinds. 3. Men eminent in each of the principal branches of science should be chosen to accompany the ship, which should first make for the Cape of Good Hope, where all the necessary scientific arrangements and testing of instruments could be made. The Cape, indeed, might be considered as the real starting point of the expedition. 4. For the purpose of regular observations, soundings, and so forth, the expedition should set out about the beginning of the year from the Cape for the various groups of islands visited by Cook and Ross, making for Christmas Haven in Kerguelen, overhauling the observations which have been arranged for now thirty years, and attempting to fix the geographical position of as many points as possible. 5. On the Macdonald Islands, as they stretch farther to the south in this quarter (53° 5·5′ S. lat., 73° 17·2′ E. long.), a depôt should be established, the chief purpose of which should be to maintain an ample stock of coals for the use of the expedition, to convey which from the Cape a transport vessel would be useful. Besides a strongly-built astronomical magnetic observatory should be erected here, which would serve as a basis of observation for the operations of the expedition in the south; for these islands are the outmost fore-posts of the Antarctic regions. 6. The ship could carry on its soundings and researches into the currents, the ocean-bed, &c., with diligence, and go as far south as the season would permit without danger. In December the attempt should be made to cross the polar circle, to force through the girdle of pack-ice, and begin research in the polar regions proper. 7. An attempt should be made, with all energy and circumspection, to winter inside the polar circle, when possibly a suitable harbour might be found on Kemp or Enderby Land. By this means the data for the winter climatology of the Antarctic regions would be ascertained, for which Science has sighed so long. On this position of observation a small contingent of eight or ten men and a whaling-boat should be left, furnished with every means for the preservation of their health and the furthering of scientific knowledge. After establishing this station, the ship itself should return to the Macdonald Islands, and pass the winter, as far as the season will permit, in pursuing scientific labours. 8. By the approach of the favourable season in September and October the work could be again transferred to the sea, and particularly a thorough survey of the Macdonald group should be made. In December the ship would again make for the south, take up the observers on Kemp's Land, and then proceed to further researches until the end of the favourable season urges a return to the Macdonald Islands. 9. At the conclusion of its work the expedition could sail for Melbourne, where the necessary arrangement of the observations could be made. 10. During the sojourn of the expedition in and around the Macdonald group, it might be arranged that a series of Australian-bound ships of all nations should from time to time sail southward and visit the island, which, during the Austral summer would be a matter of little difficulty. In this way a regular connection with Europe would be maintained, and intelligence could, now that we have telegraphic communication between Melbourne and England, reach Europe from the Macdonald Islands in from fourteen to eighteen days. Should the latter group, contrary to all expectation, prove unsuitable to a long stay, then must Christmas Haven in Kerguelen (48° 41′ 1″ S. lat. and 69° 3′ 35″ E. long.) be chosen for the purpose. Should an expedition be fitted out in connection with that for the observation of the Transit of Venus, the above plan would require to be materially modified.

Dr. Neumayer concludes with some sensible remarks on the qualifications necessary to form an efficient leader of an expedition such as he proposes; the man selected for the purpose must be both a seaman and a man of science, and no mere *dilettante* discoverer. Should such an expedition ever be organised, the importance of these considerations cannot be overrated.

FAYRER'S THANATOPHIDIA OF INDIA.

The Thanatophidia of India. Being a description of the Venomous Snakes of the Indian Peninsula, with an account of the Influence of their Poison on Life; and a series of experiments. By J. Fayrer, M.D., &c. 1 vol. folio, coloured plates. (London: Churchill, 1872.)

THIS is a handsome work, got up in good style, printed in large clear type, and illustrated with a number of highly-coloured plates. It is intended to supply a want which the author has often heard expressed—"that of reliable information on the venomous snakes of India."

Dr. Fayrer divides his subject into several sections, the first relating to the zoological and anatomical character of the venomous serpents of India, the others treating of the statistics of deaths caused by their bites, of the mode of treatment of such cases, and of numerous experiments undertaken by the author with a view of ascertaining the influence of snake-poisons, and the value of certain reputed antidotes. On each of these subjects we will make a few remarks.

As regards the more strictly scientific portion of the volume, Dr. Fayrer informs us candidly that we are not to expect anything original. "The classification and definitions are chiefly taken from, or based on, Günther, or other authors of repute, the anatomical descriptions from Owen and Huxley; and to those authorities I make my acknowledgments for much valuable information, remarking, at the same time, that I have carefully verified their descriptions by comparison with, and by dissections of, the snakes themselves." In this passage we think that it is not made sufficiently clear that the whole of the first section of Dr. Fayrer's work is based upon Dr. Günther's

"Reptiles of British India."—in fact, the classification and descriptions are mostly copied literally therefrom. It is quite true that Dr. Günther's name is frequently introduced, and that frequent passages borrowed from his work are quoted in inverted commas; but, even under these circumstances, we fail to see that Dr. Fayrer is quite justified in appropriating so largely the results of another author's labours to his own use. It would have been easy to state at once that so far as arrangement and classification went, he simply intended to follow those given in "The Reptiles of British India," and to refer his readers to that work for information on these subjects.

In the second section of his work, Dr. Fayrer gives details as to the actual number of deaths caused by snake-bites in India. These statistics were principally obtained from replies to letters on the subject addressed by him to the secretaries and political agents of the several governments. The result arrived at is that the total number of deaths recorded in 1869 in Bengal, the North West Provinces, Oude, and certain other parts of India, embracing altogether a population of about 120,000,000, was 11,416. This total, however, large as it is, Dr. Fayrer fears cannot be regarded as the real mortality in these provinces, the information upon which it is based having been partial and imperfect. Were accurate statistics obtainable from the whole of Hindostan, Dr. Fayrer believes that it would be found that more than 20,000 people die annually in that country from the bites of poisonous snakes. Such being the case, there can be no question as to the importance of the subject discussed in the work before us.

In his third section Dr. Fayrer speaks of the treatment of snake-bite, concerning which, after a certain amount of discussion, he does not appear to have arrived at any very novel results. Ligatures, scarifications, liquor ammoniæ, and hot spirits and water, are the remedies in vogue on such occasions, and to these Dr. Fayrer gives in his adhesion. "The antidotes in addition," he remarks, "may be used by those who have faith in them; but I fear that there is reason to believe that they are of no use." These antidotes, we should have explained, comprehend snake-stones, arsenic, bromine, ipecacuanha, senega, and, "indeed nearly every drug in or out of the pharmacopœia."

Numerous reports of cases of snake-bite by medical officers of the Indian Service constitute the fourth section of Dr. Fayrer's work. These have been selected in order to give a fair idea of the symptoms and of the duration of life after the reception of the bite, and of the pathological appearances after the death of the sufferer.

In the concluding portion of the volume, Dr. Fayrer gives an account of numerous experiments undertaken with a view to ascertain the influence of snake-poison on the lower animals, and the value of certain modes of treatment. These experiments were commenced in October 1867, and continued during a period of three years, the object having been to determine the effect of the bite of venomous serpents by actual observation, and to test the value of supposed remedies both internal and external. The snakes with which the experiments were performed were the Cobra, the *Ophiophagus* or Hamadryad, and the two Indian species of the genus *Bungarlus*, belonging to the Elapidæ, some of the sea-snakes of family Hydrophiidæ, the *Daboia russellii*, and the *Echis carinata*, belonging to the Viperidæ, and one species of *Trimeresurus*, belonging to the Crotalidæ, or Pit vipers. Of these Dr. Fayrer concludes that as regards deadliness the Cobra, *Ophiophagus*, and *Daboia* are very nearly on a par. "They are quite capable of destroying a full-grown dog in half an hour, sometimes in much less time; and frequently," Dr. Fayrer believes, "man has succumbed within an equally short period, though generally the time is much longer." The *Bungarlus cœruleus* is believed to be just as deadly as the above-named, but not to kill quite so quickly. The *Bungarlus fasciatus* is less fatal. The *Echis* is also very deadly, but from its small size less likely to be fatal to man. Of the sea-snakes much less is known, but it appears that human life would be in great danger from their bite. The Elapine snakes of the genus *Callophis* and the Pit-vipers of Hindostan, although capable of giving a painful and even a dangerous bite, are not nearly so deadly.

The symptoms produced by the bite of these different serpents vary slightly, but not so as to present any great physiological or pathological divergences. All alike point to "exhaustion and paralysis of the nerve-centres," every function falling rapidly, and life becoming quickly extinct. "The *post-mortem* appearances frequently reveal nothing except the marks of the fangs, or, if the creature has survived some hours, infiltration and perhaps incipient decomposition of the intestines." Warm-blooded animals are acted upon much more vigorously by snake-poison than cold-blooded animals. As regards the latter, poisonous snakes are not, according to Dr. Fayrer's experience, affected by their own poisons, or by that of one of their own species, although the less-poisonous seem to be subject to the venom of their more poisonous relatives. Lastly, although the blood of an animal killed by snake-poisoning destroys life if injected into another animal, there can be no doubt that the body of such an animal may be eaten with impunity. The fowls and pigeons killed in Dr. Fayrer's experiments were always eaten by the natives without any evil consequences following.

Such are some of the results arrived at from Dr. Fayrer's long and laborious series of experiments. We cannot say that there is any great novelty amongst them. As regards the treatment of snake-bite, indeed, it seems quite conclusively proved that the antidotes, commonly so called, are useless, and that it is hardly probable that any direct specific will ever be discovered. Cure failing, the large mortality now due to snake-bite can, therefore, only be materially diminished by prevention; and the simplest mode of prevention—slow as it may be—is, we think, that recommended by Dr. Fayrer in his circular of January 1870*, *i.e.* to offer small rewards for the destruction of the serpents. The sum expended in this way would, as Dr. Fayrer observes, no doubt be large, but the saving of human life thereby effected would be great.

OUR BOOK SHELF

Forstzoologie. Von Dr. Bernard Altum. I. Saügethiere. (Berlin: Springer, 1872. London: Williams and Norgate.)

Dr. Bernard Altum, Professor of Zoology in the Royal Academy of Forestry at Neustadt-Eberswald, gives us, in the present volume, the first of a series of essays which he proposes to write for the instruction of his pupils and others in "Forest-zoology," *i.e.*, in Zoology with especial reference to the wants of those who are engaged in the care and preservation of forests. The present volume is devoted to the class of Mammals; a second will relate to the Birds; and a third to the Insects; these being the three principal divisions of the animal kingdom with which "foresters" are mostly brought into contact. Zoology in the abstract, or "scientific zoology," Dr. Altum observes, is the foundation upon which all knowledge of the various applications of zoology must be based. Dr. Altum therefore adopts a strictly scientific arrangement for his work, commencing with a definition of the class of Mammals, and taking the various groups of this class in systematic order. The work being intended for those whose labours are to be in the forests of Central Europe, only European species are included. But the *Quadrumana*, *Prosimiæ*, and other orders restricted to foreign countries, are introduced in their proper places, and some general information concerning them, together with a short account of their leading divisions, is given. Special attention is paid to those species of Mammals which the forester is most likely to be brought into contact with, such as the squirrels, field-mice, beaver, deer, and others; and full particulars are given of the modes in which forest trees are injured or attacked by them.

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* See page 31 of Dr. Fayrer's work.

Dr. Altum's volume, thus composed, seems to be in every way well adapted for the purpose for which it is intended. Dr. Altum is fortunate in having, in Blasius' well-known work on European Mammals, an excellent guide to the scientific history of other animals, which he wisely follows. An English writer on the same subject would not be so well off, for the only modern work on British Mammals is now long ago out of print, and there seems to be no prospect of a second edition of it being published. In this, as in nearly every other branch of science, we have constantly to go to Germany for assistance.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Meteorology of the Future

I CANNOT quite agree with Mr. Lockyer that the most important question in meteorology is the discovery of a cycle. Were it even so well proved, it would still be but an empirical law. In my opinion the chief desideratum of the science is a dynamical theory of barometric waves; and the data for this are to be found not merely in records of barometric fluctuations in one place, nor by comparing the records in several places at or near the sea level, but by comparing the records at places separated by the greatest possible vertical distance, though horizontally near each other. Such records do not yet exist, and they can be had only at specially chosen stations; the summit and the base of Teneriffe, for instance, or of Etna. The latter would probably be the best, as it is in the variables. It is not at all certain that the fluctuations of the barometer at the summit and at the base of a high mountain would be nearly alike. It is stated by Kaenitz that while the barometer in the hottest part of the day falls at the sea level, it rises at a height of a few thousand feet. The reason why it rises at the higher station is that the entire column of air is lifted up by the expansion due to heat, and thus a larger proportion of the column comes to be above the station. This cause does not act at the sea-level, and the barometer there falls in consequence of the outflow of air from the top of the column. It is much to be desired that the attention of scientific men and scientific committees should be directed to this subject, as without such sets of comparative observations we shall never have all the data for a complete theory of barometric waves.

Old Forge, Dunmurry JOSEPH JOHN MURPHY

Popular Science in 1872

SCIENTIFIC information in a popular form is one of the demands of the age, and we find it supplied even in publications by no means exclusively devoted to Science. It would be a great loss, however, to the professed students of science, if they should remain unacquainted with the following remarkable contributions to our knowledge of electricity, merely because they occur in the December number of *Belgravia*, in an article entitled "Is Electricity Life?"

$\frac{dp}{dt}$

"The ocean, for instance, is compounded of water and salt; one is an electric, the other not. The friction of these causes the phosphorescent appearance so often observed at sea."

"That all created living bodies are electric there can be no question; and as little that some persons, animals, and plants, are more electric than others. Two forms of the latter are familiar. Few schoolboys are guiltless of experiments on poor puss, from whose much-enduring back electric sparks may be drawn, especially in dry frosty weather; and most young ladies have admired the elegant sensitive plant, whose leaves seem to move and feel,

"and with quick horror fly the neighbouring hand,"

that draws from it the electricity which it contains more than other plants; and its leaves at once fall flaccidly, until a new supply of electric force renders them once more turgid.

"But bodies have not only electricity within them, but an electric atmosphere, of the form of the body which it surrounds, and which is attracted by it. Without this we could not shake hands with a friend, or kiss a lip, without the danger of the excess of electricity flying off and destroying us, or the he or she that we would greet or kiss. Perhaps it is the commingling of these electric atmospheres that makes kissing so nice.

"Two conditions of the human body are also illustrative of its varied electric action. A person who has the small-pox cannot be electrified, while sparks of electricity may be drawn from the body of a patient dying of cholera. In the first instance it appears that the body is fully charged with its own electricity, since it is impossible to electrify a body beyond a certain degree; in the latter there seems to be a tendency to part with the electric force which is essential to the support of life, and which may account for the distressing and rapid weakness of cholera-patients."

Upon the Direction in which the North Magnetic Pole has moved during the last two Centuries

IN an article upon Terrestrial Magnetism in the current number of the *Edinburgh Review*, referring to the fact that the compass-needle does not now in England point due north and south, and that it changes its position slightly from year to year, but that from our present ignorance of the source and laws of this change we cannot say that it will hereafter be as much in one direction as it has been in another, the writer remarks (p. 424): "Still the strictly *progressive* character of this change compels us to regard it as the expression of some determinate cause or causes. The question then arises, Where are these to be found? Now, from whatever point on the earth's surface we contemplate the phenomenon, we find ourselves in the presence of two distinct magnetic systems. This was first clearly recognised by Halley as a necessary consequence of even the scanty information at his command, and the accumulated observations of two hundred years have corroborated in a very remarkable manner the conclusions at which he arrived—that of these two systems one was *fixed* and the other *in motion*."

It is a matter of some interest to ascertain in what directions the system in motion has gone in the interval mentioned. Sir Edward Sabine gives us some information on this point. In his paper upon Terrestrial Magnetism, in "Johnston's Physical Atlas," p. 72, he says: "The change of longitude of the stronger pole, since Halley placed it on or about the middle of California, appears to have been small; but, on the other hand, the weaker pole, which is now found in Siberia, was placed by Halley near the meridian of the British Islands, and, adopting Halley's mode of reasoning, the present disposition of the lines of declination corresponds to this change."

Of the northern poles of the two magnetic systems in Halley's time, one appears to have been in the longitude of California, the other in that of the British Islands, the former being stationary, the latter in motion; and as it is said now to be Siberia, its motion must have been from west to east. On the other hand, we find this motion described as being in the opposite direction, viz., from east to west. Sir George Airy, in his treatise on Magnetism, p. 93, remarks "that at Greenwich the dip and total force are diminishing. Interpreting these by the remarks, it would seem that the magnetic equator is approaching above Greenwich, or the north magnetic pole is receding from Greenwich; and remarking also the westerly change in direction of north magnetic meridian, from the sixteenth century to the year 1824, and its subsequent easterly motion, it would seem that the north magnetic pole has rotated round the terrestrial pole in a small circle from east to west, and, having passed the point where its westerly azimuth, as viewed from Greenwich, is maximum, is still continuing its course in that circle. It seems probable that in the fifteenth or sixteenth century it was situated between North Cape and Spitzbergen. It is now north-west of Hudson's Bay."

The north magnetic pole, which Sir E. Sabine supposes to have been in Halley's time in the meridian of the British Islands, would appear to be the same which Sir G. Airy says was probably in the 13th and 16th century in a meridian between North Cape and Spitzbergen; yet the pole referred to is in one case said to be now in Siberia; while in the other it is said to be to the north-west of Hudson's Bay; but it cannot at the same time have gone to the eastward and also to the westward.

In the two accounts there is a discrepancy, but perhaps this is apparent only, and some of your readers may be able to show how the accounts can be reconciled. X

Height of Thunderclouds

A FEW days ago I had an opportunity of estimating the height of a bank of thunderclouds, an account of which may interest the readers of NATURE.

I was camped at Gurpur, a place some eight miles from and within sight of the sea, with an elevation of about 480 feet. The evening was fine, and the horizon to westward remarkably free from haze, so much so that when the sun dipped it was still too bright for the naked eye to bear. Some fifteen or eighteen miles to eastward a heavy thunderstorm was raging, and the Western Ghâts were shrouded by immense masses of cumulus, which, piled up to an enormous height, and rosy with the beams of the setting sun, formed quite a study for an artist.

Having been in the jungles for three or four weeks, I noted, in order to get correct time, the moment the sun disappeared beneath the horizon. This was, by my watch, six minutes past six o'clock. A few minutes subsequently I noticed the earth-shadow creeping up the clouds to eastwards, its edge being singularly well-defined by the contrast of the cold grey beneath and the warm colouring above. Struck by the slow progress of the shadow, I timed it, and found that at seventeen minutes past six the last tinge of pink faded from the highest point of the cumulus, and at nineteen and a quarter minutes the cirrhi floating above the storm lost their hue, thus giving eleven minutes for the former and thirteen and a quarter for the latter. These times reduced and corrected for latitude (13° N.), give the respective approximate heights of the clouds as 14,075 and 25,590 feet, or, adding height of observer, about 2·75 and 4·93 miles.

To be on the safe side, but 10' of arc have been allowed for the eastward position of the clouds. The nature of the observations of course renders correction for refraction unnecessary, so that the above figures are well within the mark.

I believe that in the tropics cumuli attain a considerably greater elevation than is generally believed. In 1864 I was on board a vessel in lat. 2° 53' N., long. 10° 47' W., when there were constant flashes of forked lightning visible among detached clouds directly overhead, yet not the faintest growl of thunder was heard by anyone on board, although a dead calm prevailed at the time. This fact I can only attribute to the combined effect of the immense altitude of the clouds and the consequent rarity of the air. E. H. PRINGLE

Mangalore, South Canara, Nov. 2

PERIODICITY OF RAINFALL

HAVING been working at the above subject for the last ten years, it occurs to me that a brief record of my failures and successes will form an appropriate supplement to the important article by Mr. Lockyer in NATURE for Dec. 12.

Meteorologists have been hunting for a Saros throughout the present century. Among them, perhaps, the most devoted to the subject were Lieut. George Mackenzie, author of "The System of the Weather," and Luke Howard, whose "Cycle of Eighteen Years in the Seasons of Britain" is a well-known work.

What little I have done in the subject is briefly told. Almost immediately after commencing the collection of British rainfall statistics, which has now reached a completeness excelling that of any other country, my attention was naturally drawn to the question of periodicity. Knowing, however, something of the care requisite to obtain long series of observations strictly comparable, I waited five years before printing anything bearing upon it; in 1865, however, I prepared and published * the following table for fifty years, based upon the mean of continuous records in different parts of Great Britain:—

TABLE I.—MEAN DEPTH OF RAIN AT TEN STATIONS, 1815—1864

Year.	Depth.	Year.	Depth.	Year.	Depth.	Year.	Depth.	Year.	Depth.
1815	27·12	1825	26·57	1835	28·56	1845	27·87	1855	23·37
1816	29·26	1826	23·76	1836	33·49	1846	29·57	1856	25·89
1817	29·73	1827	29·53	1837	24·54	1847	25·80	1857	25·70
1818	30·34	1828	33·02	1838	27·11	1848	35·98	1858	22·79
1819	30·46	1829	28·70	1839	31·27	1849	28·51	1859	28·53
1820	24·53	1830	30·83	1840	24·67	1850	26·35	1860	33·34
1821	29·92	1831	32·28	1841	33·51	1851	26·70	1861	26·98
1822	26·63	1832	26·20	1842	25·53	1852	35·53	1862	30·37
1823	31·09	1833	29·71	1843	30·40	1853	27·38	1863	26·93
1824	30·91	1834	24·52	1844	23·72	1854	22·38	1864	22·11
Mean.	28·999		28·512		28·280		28·607		26·601

I also called attention to two features in this table, which strongly tend towards the confirmation of Mr. Meldrum's views, viz.:—(1) that the wettest years are 1836, 1841, 1848, 1852, and 1860; (2) that of these, all but two form a 12-year period, viz., 1836, 1848, 1860, to which we may now add 1872 †; (3) that the dry years were 1826, 1834, 1844, 1854, 1855, 1858, and 1864; (4) that of these, all but three form a 10-year period, viz., 1834, 1844, 1854, and 1864.

All this looked very satisfactory; but, to make assurance doubly sure, I determined to make up a longer period. This I accordingly did; and the approximate fluctuation of annual rainfall during *one hundred and forty years*, viz., 1726 to 1865, will be found in the British Association Report for 1866, page 286, *et seq.* These values were converted into ratios, and, subsequently, those for the years 1866 to 1869 were added, and the table was given in the following condensed form in an article on the "Secular Variation of Rainfall in England since 1725," in "British Rainfall, 1870." I was so disappointed at the total disappearance of both the ten- and twelve-year periods, that I cannot say that I have closely scrutinised

TABLE II.—RATIO OF THE FALL OF RAIN IN EACH YEAR SINCE 1725 TO THE MEAN FALL OF SIXTY YEARS, ENDING WITH 1869

Year.	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820	1830	1840	1850	1860
0	...	88	65	61	70	108	75	86	90	100	92	111	89	91	122
1	...	71	58	108	87	70	79	105	96	98	109	108	128	88	92
2	...	83	65	82	71	111	131	117	91	97	100	98	91	138	107
3	...	71	60	87	118	113	93	86	77	92	117	106	110	101	89
4	...	114	89	76	101	129	96	104	85	92	117	90	85	74	73
5	...	102	80	83	82	123	77	84	75	99	96	99	97	88	108
6	109	101	70	100	77	107	1·7	83	96	107	77	118	108	93	115
7	102	110	95	93	91	89	96	106	94	100	102	87	90	97	103
8	109	70	65	84	128	102	65	88	90	102	120	90	130	80	102
9	97	89	59	81	86	83	116	106	88	99	102	107	98	102	104
Mean	...	89·0	70·6	85·5	91·1	103·5	93·5	96·5	88·2	98·6	103·2	101·4	102·6	95·2	101·5

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* Brit. Assoc. Report, 1865, p. 202.

† See *Times*, Nov. 12 and Dec. 3, 1872.

he values herein given; and as I doubt if better data could be obtained, I do not think that your space would be wasted by reproducing it, and affording your readers the opportunity of detecting any periodicity which may exist.

I now turn to the verification of Mr. Meldrum's conjectured connection between sun-spot and rainfall periodicity. But before giving the results I have obtained, I think it is worthy of consideration whether the total precipitation over the surface of the globe can be expected to be increased by increased cyclonic energy. Increased rainfall surely means increased extraction of moisture from the air, and that involves one of two facts—(1) increased evaporation to supply the increased demand, or (2) rapid and great dessication of the atmosphere. Without expressing a dogmatic or fixed opinion, it certainly seems to me more likely that the effect of cyclones is simply to alter the locality of deposition, than its aggregate amount. Therefore I should by no means hold the connection disproved by series in which exactly opposite results obtain, and I am not myself sanguine as to *direct* proof being forthcoming

TABLE III.—ABSTRACT OF RAINFALL OVER THE GLOBE, 1832-68, ARRANGED ACCORDING TO SUN-SPOT PERIODS.*

	EUROPE.											ASIA.		AFRICA.			AMERICA.					
	BRITISH ISLES			FRANCE.					SWITZERLAND.		ITALY	PALESTINE	INDIA	ALGERIA.			CANADA	UNITED STATES.			S. AMERICA	W. INDIE.
	Guernsey.	Greenwich.	Sandwick, Orkney.	Tarn, Bassin de Saint Ferriol.	Haute Garonne, Toulouse.	Basses Pyrénées, Bages Beost.	Charente Inférieure, Courçon.	Paris.	Geneva.	Great St. Bernard.	Rome.	Jerusalem.	Calcutta.	Algiers.	Oran.	Constantine.	Toronto	Philadelphia.	New York, Fort Columbus.	Massachusetts, New Bedford.	New Granada, Marmato.	Barbadoes
Year.	in.	in.	in.	in.	in.	in.	in.	in.	in	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1832		19·3		23·5	21·4		18·9	21·4	20·7	39·8	22·8							39·3		41·8		
1833		23·0		34·2	33·2		22·9	23·4	29·8	73·1	26·0							48·4		37·9		
1834		19·6		24·6	20·4		18·1	18·2	24·4	58·9	13·0							35·1		40·1		
Totals		61·9		82·3	75·0		59·9	63·0	74·9	171·8	61·8							122·8		121·8		
1836		27·1		26·8	23·6		32·4	28·0	27·0	98·0	30·8							43·0	27·6	38·1	100·0	
1837		21·0		23·0	25·6		22·0	24·6	20·7	53·9	25·1							37·1	65·5	34·7	88·4	
1838		23·8		22·3	26·1		31·6	24·1	35·5	93·9	31·4							44·3	41·9	34·0	113·4	
Totals		71·9		72·1	75·3		86·0	70·7	83·2	245·8	87·3							124·4	135·0	106·8	301·8	
1843	37·7	24·6	38·4	29·0	31·9	51·4	30·9	24·1	36·5	34·9	21·3		64·3	30·1	10·9			46·5	41·4	45·0	64·8	45·3
1844	27·7	24·9	32·1	35·3	34·8	52·0	29·8	27·0	34·4	66·1	30·6		73·0	41·2	20·8			38·8	36·4	36·2	88·4	74·5
1845	33·3	22·4	40·9	29·7	32·1	68·6	26·5	26·5	35·7	60·2	38·3		63·1	41·2	24·4			40·3	34·1	42·7	70·5	43·9
Totals	98·7	71·9	111·4	94·0	98·8	172·0	87·2	77·6	106·6	161·2	90·2		201·3	112·5	56·1			125·6	111·9	123·9	223·7	163·7
1847	29·2	17·8	40·8	17·7	19·0	27·2	19·2	19·6	27·3	42·0	31·6	67·6	72·4	51·4	18·4				64·9	40·8		42·5
1848	48·0	30·2	37·8	25·7	30·0	39·6	25·4	24·9	33·5	62·4	25·4	48·2	58·7	40·5	23·1				36·8	36·2		62·8
1849	36·4	23·7	40·5	29·1	23·6	41·0	22·9	26·3	33·9	57·5	20·6	60·0	65·5	22·0	12·6				31·7	32·4		53·0
Totals	113·6	71·7	119·1	72·5	72·6	107·9	67·5	70·8	94·7	161·9	77·6	175·8	196·6	113·9	54·1				133·4	109·4		158·3
1855	30·4	21·1	35·1	31·1	25·6	49·5	28·9	15·7	40·2	46·1	32·3	61·0	70·4	21·5	21·5	16·1	41·6					73·5
1856	34·4	22·2	27·4	44·6	31·9	48·8	27·4	25·0	41·0	44·1	28·3	94·0	64·2	28·7	20·5	15·4	28·1					46·4
1857	31·9	21·4	31·9	31·9	26·8	40·6	31·0	21·5	21·1	22·9	30·2	104·2	69·0	35·4	35·7	24·7	40·6					50·8
Totals	96·7	64·7	94·4	107·6	84·3	138·9	87·3	62·2	102·3	113·1	90·8	259·2	203·6	85·6	77·7	56·2	110·3					170·7
1859	43·4	25·9	44·4	31·0	23·9	28·0	30·0	23·2	26·9	36·7				35·3	15·3	31·5	39·8					55·1
1860	48·0	32·0	38·0	29·3	25·8	40·0	37·0	29·4	41·3	56·3				26·5	18·4	23·0	28·0					60·4
1861	31·2	20·3	41·2	31·0	26·0	23·9	25·9	18·8	30·7	31·7				21·4	13·9	14·9	34·5					71·1
Totals	122·6	78·2	123·6	91·3	75·7	91·9	92·9	71·4	98·9	124·7				83·2	47·6	69·4	102·3					186·6
1866	44·4	30·1	41·6																			
1867	37·1	28·5	39·4																			
1868	34·8	25·2	43·4																			
Totals	116·3	83·8	124·4																			

I do not quite agree with my distinguished friend Mr. Meldrum as to the "disturbing influence of continents." Their outlines and mountain ranges change not, and I am aware of no evidence to show that the annual fluctuation of rainfall is disturbed by continents. Moreover, in the case of some of the smaller islands, we have illustrations in support of the views of Becquerel and the Hon. G. P. Marsh which would completely mask any influence indicated by Mr. Meldrum's statistics. I have no doubt that Mr. Meldrum knows the facts respecting the rainfall in the Isle of Ascension better than I do, and I think that perhaps upon reflection he will be inclined to slightly lessen his claims for the superiority of insular stations.

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* Want of space compels us to omit a similar column referring to the rainfall of Australasia.

I am aware of the rather "heavy" nature of the accompanying table, but the matter is one of much importance and entirely dependent on observed facts, therefore I think you will consider it worthy of the space it will occupy. I have condensed it as much as possible, and have, to the best of my knowledge, selected the most trustworthy and longest continued records at present in my hands.

Having thus placed the data before your readers, it seems undesirable to occupy space with remarks as to my own opinion on the evidence; but I cannot help thinking that it is quite clear that the question must not rest where it is. The evidence is no doubt conflicting; but I cannot think that it is chance alone that has given us (from Table I.):—

Maximum sunspot years	1837	1848	1860	1871 ?
Heavy rainfall "	1836	1848	1860	1872
Amount of rainfall	33·49	35·98	33·34	? 34
Per cent. above average	19	28	18	? 20
Minimum sunspot years	1833	1844	1856	1867
Small rainfall "	1834	1844	1858	1868
Amount of rainfall	24·52	23·72	22·79	? 28·8
Per cent. below average	13	16	19	+ 2

Almost identical results are given by Table II.

G. J. SYMONS

MAX MULLER ON DARWIN'S PHILOSOPHY OF LANGUAGE *

IN a lecture recently delivered in connection with the Liverpool Literary and Philosophical Society, Prof. Max Müller addressed himself to the phase of Mr. Darwin's theory, which deals with the possibility of the higher animals acquiring the faculty of articulate speech. He first cleared the ground by some general remarks on the previous phases of this old, old controversy touching the origin and destiny of man, referring to the contention between the Materialists and the Idealists, and to the durable impression left upon this controversy by Kant's wonderful "Criticism on Pure Reason," lamenting that Mr. Darwin and his followers should disregard the important conclusions resulting from previous controversies on this subject, and proceed as if their theory of evolution were new. Materialism, he said, is everywhere in the ascendant, while Idealism is almost become a term of reproach. In this riddle of mind and matter, the world is the theatre of a struggle for the primacy of mind over matter. But when the evolutionists contend that the development of the mind of man out of the mind of an animal is a mere question of time, the Professor felt inclined to treat the idea with impatience. Animals must be animals so long as they lack the faculty of abstracting general ideas. Darwin says: "I believe that animals have descended from at most four or five progenitors, and plants from an equal or lesser number. Analogy would lead us one step further, namely, to the belief that all animals and plants have descended from some one prototype. All organic beings have descended from some primordial form into which life was breathed by the Creator." Prof. Max Müller inferred that these four progenitors may be intended for the Radiata, Mollusca, Articulata, and Vertebrata; and said that Mr. Darwin holds firmly that man has been developed from some lower animal, that all animals have been so developed from the lowest to the highest order of organism, and that there is nothing peculiar in man which cannot be explained from germinal seeds or potential faculties existing in lower animals. This question of the descent of man may be called the controversy of the nineteenth century, and requires the whole knowledge of the century to answer it adequately. The lecturer, confining himself to the evolution theory as it affects language, essayed to show that between the language of animals and the language of man there is *no* natural bridge, and that to account for human language such as we possess would require a faculty of which no trace has ever been discovered in lower animals. If, as Mr. Darwin begs us to assume, there were a series of developments graduating insensibly from ape to man, it would of course be impossible to fix a definite point where the ape ended and the man began; but he asks us to assume that which does not exist, and without evidence to support this, of which there is none, the theory remains only a theory. Indeed, said the Professor, whenever the distance between two points in the chain of development seems too great, we are told again and again that we must only imagine a large number of intermitted beings representing gradations insensibly sloping up or sloping down, in order to remove all difficulty. So it is in the case between the monkey and the man. This point was illustrated most appositely by reference to the Hindoo notion that man is descended from the spirit of the Creator, through a series of links now extinct, the first descendant being 9-10ths God and 1-10th man, the second being 8-10ths God and 2-10ths man, and so on till man became 10-10ths man and ceased to be of the essence of the Great Spirit. Mr. Darwin's fallacy, he said, lurks in the very word "development," for the admission of this insensible gradation through a series of organised beings would eliminate not only the difference between ape and man, but likewise the difference between peat and coal, between black and white, between high and low—in fact it would do away with the possibility of all definite knowledge. Mr. Darwin admits that articulate language is peculiar to man, but contends that animals have, in a lower stage of development, the identical faculties necessary to the invention of articulate expressions. To this he replied that no development of mental faculties has ever enabled any animal to connect one single definite idea with one single definite word. He gave various illustrations of the essential difference between the expression of emotions and the expression of ideas or abstract conceptions, and argued at length as to the impossibility of mere emotional signs and sounds developing into articulate speech; and he ridiculed the notion that the materials of language being given, all the rest was a mere question of time, a natural gradation from the neigh of the horse to the poetry of Goethe. Man and animals possess emotional language in common, because man is an animal; but animals do not possess rational language, because they are not man. This distinction between emotional and rational language, so far from being fanciful and artificial, is radical, as proved by various evidence, especially by the testimony of pathology in reference to certain brain diseases. Rational language is to be traced back to roots, and every root is the sign of a general conception or abstract idea of which the animal mind is incapable. Mr. Darwin has said there are savage languages which contain no abstract terms; but the names for common objects, such as father, mother, brother, &c., are abstract terms, and unless Mr. Darwin is prepared to produce a language containing no such names, his statement, said the lecturer, falls to the ground as the result of a misconception of the real nature of a general idea as distinguished from an emotion. This phase of the controversy lies within the Professor's peculiar domain, and he was able to entertain his audience with technical illustrations that in ordinary hands must have proved tedious, but in the hands of the most accomplished linguist of the day proved a source of wonder and amusement to his hearers. He concluded as he had begun, by maintaining that language is the true barrier between man and beast.

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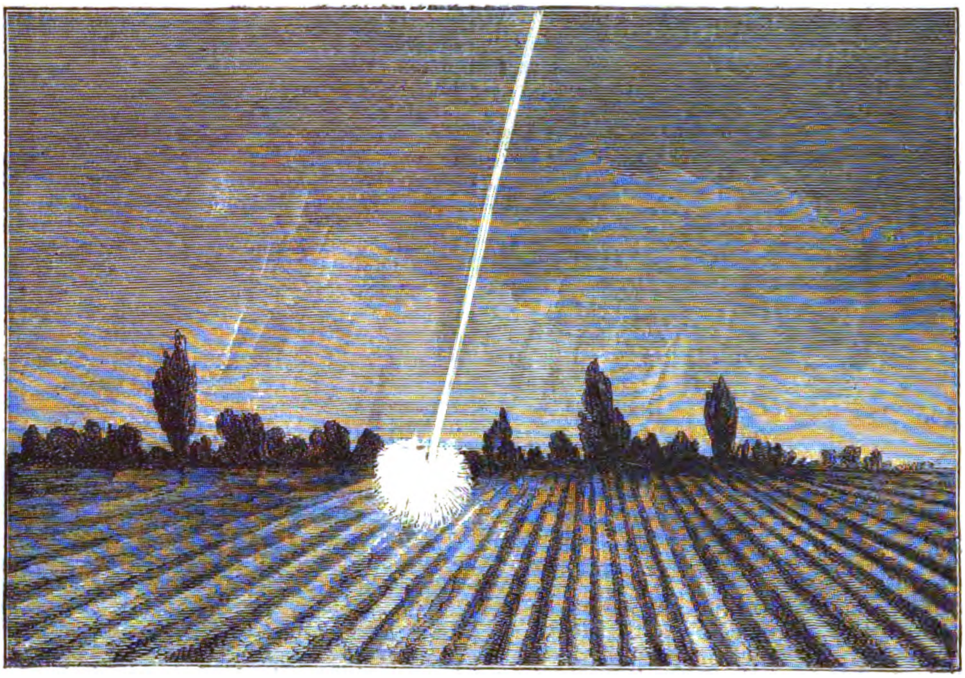
* The following extracts have been forwarded to us by the lecturer, and are taken from the *Liverpool Gazette*.

CURIOUS FIREBALL

SIR J. C. COWELL has kindly sent the accompanying sketch of a fireball which he saw fall "one mile east of Slough at 2.8 P.M. on November 30 last," during the short and sharp thunderstorm which passed over North Hants and East Berks. "The flash fell about 150 yards south of the G. W. Railway, and terminated with the explosion of a fireball, which seemed (it was daylight) about 12 ft. in diameter. The explosion was similar to that of a heavy gun when fired, and the ball appeared to burst on the flash reaching the ground, exactly like a well-timed shell."



Fire-ball seen near Slough, Nov. 30.

RECENT DISCOVERIES IN THE GREAT PYRAMID OF EGYPT—ANCIENT EGYPTIAN WEIGHT

IN addition to the casing-stone of the Great Pyramid, mentioned in NATURE of Nov. 28 as having recently arrived in England, Mr. Dixon has also sent the following articles found by him in newly-opened passages of the Great Pyramid:—

1. A small double hook of bronze, with rivetted pins for attaching it to a handle.
2. A small rectangular rod of cedar, broken at one end, and some fragments.
3. A granite ball, supposed to be an ancient weight.

Not the least curious and interesting part of Mr. Dixon's discovery is that of the passages or channels in which these articles were found. The publications of Prof. Piazzi Smyth and others have made us acquainted with the position of the King's Chamber in the central part of the Great Pyramid, with its coffer, and ascending passages leading from it; as well as with that of the Queen's Chamber, with its walls formed of the finest and whitest limestones, highly worked, this chamber having but one entrance by the horizontal passage leading to it, and its purpose proving such an enigma to our Astronomer Royal for Scotland. In examining the walls of the Queen's Chamber, with the view of ascertaining whether there existed any air channels communicating with it, similar to those of the King's Chamber, discovered by Colonel Howard Vyse in 1837, Mr. Dixon found, by inserting a wire between the joints of the masonry of the south wall, that there was a hollow space behind this part of the south wall.

On drilling a hole through the upper part of the second stone from the floor, about midway between the east and west walls, at five inches depth a cavity was found, and the hole was then enlarged sufficiently to admit a man's head and arm with a lighted candle. A passage or channel was thus disclosed, nearly nine inches by eight in rectangular section, which had been carefully cut through the stone to within five inches of the face of the wall in the Queen's Chamber, the end surface being accurately squared and finished off. This channel extended in a horizontal direction for the length of seven feet, and then ascended at an angle of about 32°. The sides of the channel were found to be blackened with smoke, like the walls of the Queen's Chamber, and it was thought that a slight draught was perceptible. The bronze hook was discovered lying amongst a small heap of *débris* at the bottom of the ascending channel.

This channel on the south side of the Queen's Chamber having been discovered, which appeared to be precisely similar to the air channel of the King's Chamber, and to ascend at the same angle, an attempt was naturally made to find a corresponding channel behind the wall on the north side of the Queen's Chamber, though no indication of any such channel presented itself on the surface of the wall. After using measuring rods to mark a spot exactly opposite to the drilled hole on the south wall, a hole was bored in the north wall, and a similar cavity was at once found. By enlarging the opening as before, a second channel was discovered of the same dimensions, and which, after proceeding horizontally for seven feet, also ascended at an angle of about 32°.

The surface of the stone in the channel on the north side appeared to be as clean as when originally cut, and the cement of the joints was perfectly white. There was a handful or two of *débris* of lime at the bottom of the ascending portion of the channel, which had apparently fallen during the construction, and amongst this *débris* were found the granite ball and the piece of wooden rod and fragments. There was no indication of any draught in this north channel, and indeed the untarnished state of its walls, when opened, afforded the strongest proof that it was securely closed up. Hence the certain antiquity of the granite ball and wooden rod.

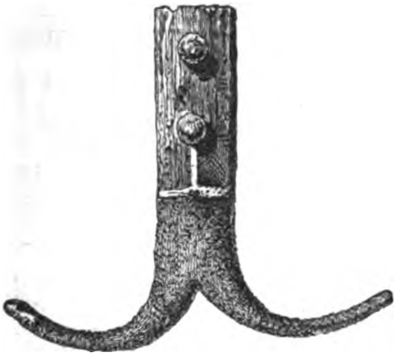


FIG. 1.—Bronze hook.

No trace of any outlet or opening to either channel could be discovered on the exterior of the Pyramid. Experiments were made by firing a pistol in the ventilating channel of the King's Chamber, at the same time holding a lighted candle at the opening of the channel in the Queen's Chamber, and *vice versâ*, with the view of ascertaining if there was any communication between them; but no such connection could be perceived.

Some borings were also made in the stones of the east and west walls of the Queen's Chamber, but without finding any cavity behind them. The discovery of these channels, which may be called "Dixon's Channels," in no way tends as yet to solve the enigma of the Queen's Chamber, but rather to increase the difficulties of the solution. The mystery of the interior of the Great Pyramid remains still to be fathomed.

1. The bronze hook (Fig. 1) is covered with green oxide of copper, but a small notch recently made in it with a file shows it to be of bronze or gun metal. The two pins have a large rivetted head on both sides. Its length is 1·8 inch, and the distance from the two extremities of the hooks is two inches. With a wooden handle attached by the two pins, it may have been used as a tool of some kind. It is probably the most ancient specimen of bronze now existing.

2. The fragment of the cedar rod (Fig. 2) is 5 inches in length, with a rectangular section of 0·5 inch by 0·4 inch. Its sides are not accurately planed, and they bear parallel lines like file marks. It may possibly have formed part of a measure of length; or it may have been part of the handle of the bronze hook, the remaining fragments showing that it must have been at least 3 inches longer. There are no lines or marks upon it indicating a measure of length.

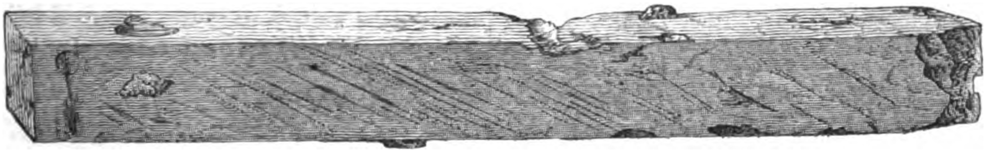


FIG. 2.—Fragment of cedar rod.

3. The gray granite ball (Fig. 3) has a mean diameter of 2¾ inches. Its form is that of an orange squeezed somewhat out of its natural shape. Its greatest diameter is 2·88 inches, and its least 2·65 inches. Its surface is uneven, and shows no mark of any tool, and it presents the appearance of having been roughly rounded by being shaken in a vessel with other stones. On the surface when found were several white spots of lime or plaster. In this condition it has been accurately weighed in the Standards Department, and its weight was found to be 8,324·97 grains. After this weighing, the lime or plaster was carefully removed and preserved, when the weight of the granite ball was found to be 8,322·4 grains, equivalent to 539·282 metric grammes.

It next remained for consideration how far the weight of this granite ball, which must have remained undisturbed in the Great Pryamid for not much less than 4000 years (the date more generally ascribed to the construction of the Great Pyramid, being 2200 B.C.) agrees with any of the ancient Egyptian weights.

According to Dr. Arbuthnot, as quoted by Dr. Young in his article "Weights" in the Enclycopædia Britannica, the ancient Egyptian Mina weighed 8,236 English grains, or 532·683 grammes, thus differing not very much from that of the granite ball. But later authorities do not agree with this weight of the Egyptian Mina. According to them the ancient weight nearest to that of the ball is the Babylonian Mina = 544·5 grammes.

Prof. Miller, in his account of the New Standard Pound, (p. 755) has shown that in frequent instances, the Imperial modern pound, or unit of weight, differs very little from, and is therefore derived from, the ancient Egyptian Mina. It may therefore be interesting to pursue the inquiry more closely.

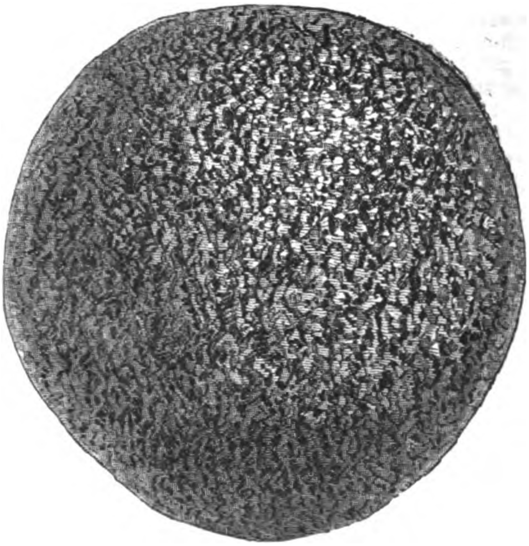


FIG. 3.—Gray granite ball.

Perhaps the fullest account of ancient weights and measures is to be found in Don. V. Quiepo's *Essai sur les systèmes Métriques des Anciens Peuples* (Paris, 1849) which contains much curious and instructive information on the subject, as well as reference to the best existing authorities.

It would appear that very little is known of the system of Egyptian weights previous to the time of the Ptolemies, the first of whom, Ptolemy Lagus, one of the Generals of Alexander the Great, became King of Egypt, 323 B.C. It is also stated that there is no certainty of the existence of any Egyptian weights which were constructed much before that period. But there is evidence that the ancient system was continued by Ptolemy Lagus, when he reformed the Egyptian weights and measures, although it can hardly be imagined that the Egyptian unit of weight remained unaltered for nearly twenty centuries. The earliest systems of weights and measures not only in Egypt, but in Assyria and Phœnicia, were based on the same principle, that of the length of the cubit and of the foot, which were to each other in the proportion of 3 to 2. The Cubit was the unit of length measure; the measure of a cubic foot of water (*Metretes*) was the unit of capacity both for liquids and dry goods; the Talent or the weight of a cubic foot of water, was the larger unit of weight, whilst the Mina, either the 50th, 60th, or 100th part of the talent, and the Sicle or Shekel, either the 40th, 60th, or 100th part of the Mina, were the smaller units of weight.

The great Alexandrian Talent of Ptolemy Lagus has been shown to have weighed 42·480 kilogrammes. The 60th part was the Mina = 708 grammes, the 50th part of which was the Didrachma or Shekel = 14 grammes. This was also the weight of the Jewish Shekel of the Sanctuary, often mentioned in the Old Testament.

Another Talent was also in use which was half the weight of the Great Talent, its Mina weighed 354 grammes, and the Drachma 3·54 grammes. Don. V. Quiepo mentions the fact of there being now in the Louvre two ancient Egyptian standard weights of roughly rounded stone, weighing 352·16, and 176·75 grammes respectively, evidently Mina and half-mina weights, as well as a similarly rounded stone weight, marked with six lines of hieroglyphics, found to weigh 414 grammes; this is thought to be an Attic Mina, known to be used in Egypt in the time of the Ptolemies, the weight of which was 425 grammes. There are also in the Louvre three ancient Egyptian bronze weights, weighing respectively 3·57, 3·56, and 3·62 grammes, evidently drachma weights.

Let us now endeavour to ascertain the length of the Cubit at the period of the construction of the great Pyramid, and thence deduce the weight of the ancient Egyptian Mina. In this computation it will be desirable to make use of metric weight and measure, from their great convenience in expressing the measure of length, capacity, and weight, by the same significant figures. The weight of water in relation to its bulk will thus be taken as determined for the metric system, that is to say, of pure water at its maximum density.

The latest and most satisfactory information on the length of the Cubit during the construction of the Great Pyramid, is to be met with in the Notes of Sir Henry James, published in 1866, with reference to the measurements made in the previous year by Ordnance Surveyors.

Herodotus, writing 450 B.C., says that "the Egyptian Cubit is equal to that of Samos" that is to say, to the Greek Cubit.

Now the length of the Greek Cubit has been satisfactorily ascertained from a recent measurement of the Hecatompedon of the Parthenon of Athens, being the platform on which the columns stand, and the exact length of 100 feet. The Greek foot has thus been found to be equal to 12·16032 English inches, and, adding half its length (6·08016 inches), shows the length of the Greek cubit to be 18·2405 inches. This, therefore, was the length of the Greek cubit 2,320 years ago, and, according to Herodotus, also the length of the Egyptian cubit.

But it has been considered by the greatest authorities that the length of the Egyptian cubit at the period of the construction of the Great Pyramid may be ascertained from the dimensions of the Pyramid itself.

Sir Isaac Newton, in his celebrated "Dissertation on Cubits," says that it is very probable that at first the Measure of the Great Pyramid was determined by some round number of Egyptian cubits.

According to the measurement of the four sides of the base of the Great Pyramid, as it must have stood when complete with its casing stones, the mean length of each side, as measured by Mr. Inglis in 1865 (Prof. Piazzi Smyth's "The Great Pyramid," vol. ii. p. 134), and by the Ordnance Surveyors in 1868, was 9,120 English inches, or 760 feet.

But 9,120 inches are precisely equivalent to 500 Egyptian or Greek cubits of 18·2415 inches.

From the measurements by Col. Vyse and Mr. Perring of the second and third Pyramids it would also appear that the same unit of length was used, the base of the second pyramid being a square of 700 Egyptian feet, and that of the third 350 Egyptian feet. Assuming, therefore, 500 ancient Egyptian cubits, or 750 Egyptian feet, to have been equal to 760 English feet, the Egyptian foot equals 1·013 English foot, or 30·86 centimetres.

The Talent derived from the weight of water contained in this Egyptian foot would be equal to 29·3892 kilogrammes, and the Mina, its fiftieth part, would equal 587·76 grammes. These weights agree very nearly with those of the ancient Phœnician weights, used as commercial weights in Egypt in the time of the Pharaohs—viz., the Kikkar (equal to 29·360 kilogrammes) and the Mina of the market (equal to 587·213 grammes), as shown by Don V. Quiepo.

This *common* or profane cubit (equal to 18·2415 English inches, or 46·319 centimetres) is to be distinguished from the *sacred* cubit or *cubit of Memphis*, as it has been termed by Sir Isaac Newton, equal to 20·628 inches, or 52·379 centimetres, which was derived by him from the *interior* dimensions of the Pyramid, and more particularly from the length and breadth of the King's Chamber, taken to be twenty and ten cubits respectively. The cubits cut on the Nilometer at Cairo now measure 20·699 English inches, or 52·559 centimetres, leaving no doubt of their being intended to be cubits of Memphis.

The double or *Royal cubit of Memphis* would thus, according to Isaac Newton, be 41·256 English inches. An ancient Royal cubit found at Cairath, is now in the British Museum, the length of which has been found to be 41·398 inches, or 105·118 centimetres, being exactly double the Nilometer cubit. It is divided into fourteen palms (of 2·956 inches, or 75 millimetres), and the palm into four digits (of 0·739 inches, or 18·7 millimetres). The length of its cubit differs only 0·071 inches from the length as deduced by Sir Isaac Newton.

The Chaldæo-Hebraic, or sacred Jewish Cubit was taken by Sir Isaac Newton to be $\frac{1}{5}$ longer than the cubit of Memphis, and thus to be equal to 24·84 English inches. This was the first result of his investigations, and it agrees with an actual measurement by Mersennus of 24·83 inches. This cubit was probably divided into six palms of 4·14 inches, ten of which would be very nearly equal to a Royal Cubit of Memphis, in terms of which the interior dimensions of the Great Pyramid appear to have been set out, as well as those of the second and third Pyramids.

It is very probable that the ancient cubit of Memphis, several of which have been found in buildings, was used in the measurement of buildings, whilst the cubit of 18·24 inches was employed for measuring land only.

The Egyptian foot corresponding with the cubit of Memphis, of 20·628 inches, derived from the Great Pyramid, would be equal to 13·752 English inches, or 1·146 feet, and to 34·919 centimetres. The weight of water contained in such a cubit foot would be 42·578 kilogrammes, thus closely approximating to the weight of the great Alexandrian Talent in the time of the Ptolemies.

These investigations show that it is quite possible that the granite ball now found may have been an ancient Egyptian Mina weight. It has been suggested that it may have been used as a hammer, as it is known that at early periods stone balls were so used; and indeed, a part of the surface of the ball looks as if some of the granite had been knocked away. But even if so used, it by no means follows that it was not originally intended as a weight, for evidence was given before the Standard Commission by our Local Inspectors of Weights and Measures that brass standard weights not unfrequently show evident marks of having been used as hammers. If a portion of the weight had thus been knocked off, the difference between its present weight of 539·282 grammes, and the weight of the ancient Egyptian commercial Mina of 587 grammes, might be readily accounted for. Assuming the granite to have been really an Egyptian weight, it must be the most ancient weight now existing.

Some words may be added, in conclusion, upon the possibility of ascertaining the unit of ancient Egyptian weight from the internal dimensions of the coffer in the King's Chamber of the Great Pyramid, this coffer of red granite having been often considered to be a standard measure of capacity. Its internal dimensions were accurately measured by Prof. Piazzi Smyth, and were determined as follows:—

Mean length = 77·93 inches
„ breadth = 26·73 „
„ depth = 34·34 „

The capacity of the coffer is thus equal to 71·532 cubic inches, or 41·396 cubit feet, equivalent to 1171·129 cubic decimetres, showing its contents of water to weigh 1171·129 kilogrammes, equivalent to 2581·89 avoirdupois pounds; or, if the English weight of the cubic foot of water at its ordinary temperature, viz. 62·321 lbs., be taken, the contents of the water would weigh 2579·840 lbs. This result is in no way commensurable with the unit of weight derived from either of the before-mentioned ancient units of linear length, nor do the measurements of the coffer agree with any round number of such units of length. The coffer thus fails to afford an indication to the unit of ancient Egyptian weight, according to this mode of computation.

H. W. C.

THE DIATHERMANCY OF FLAME

IT will be seen by the following exposition that the criticism contained in the article written by W. Mattieu Williams, published in NATURE, vol. vi. pp. 506, 507, is based on wrong assumptions.

The apparatus illustrated in NATURE, vol. vi. p. 458, was constructed for the purpose of determining certain questions connected with the passage of solar rays through flame. Incidentally it admits of being employed for ascertaining the retardation suffered by artificial radiant heat in passing through a series of flames. The table before published contains the result of a recent preliminary experiment instituted to show that the transparency of flame is too imperfect to warrant the important inference which Père Secchi has drawn from Père Provenzali's experiment with a series of small flames.

The assumption that the experiment published in NATURE was intended to settle the abstract question of diathermancy is wholly gratuitous. Probably there is no problem within the range of experimental philosophy more difficult, or requiring more time, patience, and delicate instruments for its solution, than the diathermancy of flame.

Regarding the supposed imperfections of the apparatus under consideration, the following statement will suffice:—1. Mr. Williams asserts that the main pipe to which the burners are applied is too small to afford a full supply of gas. The internal diameter of this pipe is 0·75 ins. = 0·4417 square ins. Now, it has been long established in practice that an opening of 0·0037 sq. ins. is capable of discharging six cubic feet of gas per hour, under ordinary pressure. Mr. Williams's seventeen burners consumed, agreeably to his statement, *five* cubic feet of gas per hour. The sectional area of the supply pipe, imagined to be too small, is therefore $\frac{0{\cdot}4417}{0{\cdot}0037}$ = 119 times greater than the area of an opening capable of discharging more gas in a given time than the quantity consumed by the seventeen burners employed by the author of "The Fuel of the Sun." 2. The assumption that the prolongation of the axis of the conical chamber passes through "much of the blue portion of the flame" is groundless. The distance of the gas-pipe from the conical vessel, during the experiment, was so adjusted that the prolongation of the axis of the latter passed through the flames at the point of greatest intensity. But, had this adjustment been neglected, the radiant heat, acting on the thermometer, would not have suffered any diminution, since the intensity transmitted depends solely on the extent of the ignited portion of the flame. The criticism regarding the position of the axis of the instrument has therefore no bearing on the question at issue. 3. Mr. Williams's disquisition relating to the retarding influence of the vapour contained in flames, so far from establishing the perfect diathermancy assumed by Père Secchi, proves, if we admit the soundness of the reasoning, that radiant heat does not pass freely through flames when arranged in the manner adopted by Père Provenzali. It will be well to observe that the plan of igniting one flame at a time in order to ascertain the radiant power transmitted by each was resorted to with a view of deciding the question by a similar method to that adopted by the Italian physicists.

The apparatus contrived by Mr. Williams for determining the diathermancy of flame, as described by himself, is exceedingly faulty, the temperature it records being that produced by heat received from several sources. The radiant heat transmitted to the bulb of the thermometer by the flames, acting conjointly with the unknown degree of heat imparted by the surrounding medium, it will be evident that Mr. Williams's device is worthless as an indicator of radiant intensity. His thermometer, agreeably to the published table, indicated 19° C. when exposed to a single flame, and 53° C. when all the flames were ignited; but no information is afforded regarding the temperature of the enclosure (an imperfectly polished vessel) nor was the temperature of the air surrounding the bulb of the thermometer ascertained during the experiment. It is scarcely necessary to explain that in the absence of any indication of the temperature of the air surrounding the bulb of the thermometer, and the temperature of the vessel which radiates towards the bulb, the radiant intensity transmitted by the several flames cannot be determined. Again, Mr. Williams's table, as before stated, shows that the thermometer indicated 19° C. under the effect of the radiation of *one* flame, but this temperature being the joint result of heat radiated towards the bulb by the enclosure, and heat communicated by convection of the air surrounding it, together with the radiant heat transmitted by the flame, the temperature due to the radiation of the latter, viz., the true radiant intensity, cannot be established. Experimenters possessing necessary experience are aware that a thermometer of proper form exposed to radiant heat of moderate intensity requires from twenty to twenty-five minutes before the mercurial column becomes so nearly stationary that the indication may be safely recorded; hence, owing to the close proximity o the flames, a considerable augmentation of the temperature of the air surrounding the bulb of the thermometer takes place unless the enclosure, by means of a circulating external cold medium, is maintained at a constant temperature.

Mr. Williams' assumption that the intensity of a gas flame is proportional to the quantity of gas consumed, requires some consideration. Persons practically acquainted with the subject of combustion are well aware of the fact that the intensity of a flame depends on its form and the manner of applying the oxygen, the quantity of combustibles consumed being a subordinate element in the determination of intensity. The annexed table exhibits the result of an experiment just concluded, instituted to determine accurately how far the radiant intensity transmitted by a single gas flame depends on the quantity of gas consumed :—

Consumption of gas per hour.	Temperature of medium surrounding the thermometer.	Temperature indicated by thermometer.	Radiant intensity transmitted by the flame.
Cubic feet.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1·0	60·0	60·63	0·63
1·5	60·0	60·90	0·90
2·0	60·0	61·12	1·12
2·5	60·0	61·30	1·30
3·0	60·0	61·47	1·47
3·5	60·0	61·61	1·61
4·0	60·0	61·74	1·74
4·5	60·0	61·84	1·84
5·0	60·0	61·93	1·93
5·5	60·0	62·01	2·01
6·0	60·0	62·08	2·08
6·5	60·0	62·14	2·14
7·0	60·0	62·19	2·19

It will be seen at a glance, on examining our table, that the radiant intensity transmitted to the thermometer (placed at a considerable distance from the flame, in order to reduce the subtended angle) is not proportional to the quantity of gas consumed. For instance, the differential temperature called forth by the consumption of 7·0 cubic feet of gas per hour is 2°·19, while a consumption of 3·5 cubic feet produces 1°·61, in place of the theoretical temperature $\frac{3{\cdot}5 \times 2{\cdot}19}{7{\cdot}0} = 1^{\circ}{\cdot}09$; thus showing a discrepancy of $1{\cdot}61 - 1{\cdot}09 = 0^{\circ}{\cdot}52$. Again, the consumption of 1·0 cubic feet per hour, instead of developing a temperature of $\frac{1 \times 2{\cdot}19}{7} = 0^{\circ}{\cdot}31$, we find that fully twice that degree of heat is imparted to the thermometer. The reason is obvious ; but it is not intended on this occasion to enter into a discussion of the cause of the stated discrepancy, the object being simply to show the irrelevancy of Mr. Williams' criticism concerning the absence of a record of the quantity of gas consumed.

J. ERICSSON

NOTES

WE are very glad to read the strong and earnest terms in which Mr. Gladstone on Saturday, at the distribution of prizes at the Liverpool College, spoke of the enormous waste of power shown in the administration of our English University endowments, the amount of which is probably equal to that of the whole of the endowments of continental universities taken together, whereas, perhaps, in no other country is there less absolute work to show. England contrasts most unfavourably in this matter with almost every other country in Europe, including her northern and certainly much poorer sister, Scotland. We hope the words of the Prime Minister are an earnest that he will do his best to put an end to this humiliating state of things.

IN the Washington daily *National Republican* newspaper of Dec. 4, a report of Prof. Tyndall's first lecture there is given. The contrast between the first and last paragraphs is very transatlantic.—"Every available inch of room in Lincoln Hall was occupied last evening by an audience distinguished for its appreciation of learning and its enthusiasm in the presence of a great teacher. Conspicuous in the vast assemblage were the faces of citizens eminent for their own advancement in science—citizens who have won imperishable laurels in scaling that mountain on whose jeweled and glittering apex the feet of Prof. Tyndall rest. They were there, the guests of a brother, at an intellectual feast so rich and rare that the profoundest learning, combined with the highest form of genius, was required to prepare and serve it. Prof. Henry, in a short introductory speech, presented Prof. Tyndall to the audience. The lecture throughout was of absorbing interest, and all the experiments and teachings were made so clear and simple that a child could understand them. However, if the old gentleman who was hugging and talking with a young girl all the time, will keep away from the next lecture, those who were annoyed by him will feel thankful." The Washington *Morning Chronicle* of Dec. 6 thus refers to the second lecture—"Another brilliant audience crowded Lincoln Hall to repletion last evening to listen to the distinguished English scientist. Conspicuous in it were President Grant and Miss Nellie, who evinced their interest by undivided attention to the lecturer and his brilliant experiments, Secretary Robeson, Postmaster-General Creswell, and many other of our chief dignitaries. Of course it is useless to protest against the dictates of fashion, but we would like to suggest to the ladies that if they must wear the two-story hats now in vogue, they leave out the tall feather for the benefit of those who have to sit behind them."

THE Council of the Zoological Society have conferred the silver medal of the Society on Mr. A. D. Bartlett, superintendent of the Society's gardens, "in recognition of his valuable services to the Society, and in commemoration of the birth and successful rearing of the young hippopotamus, born on Nov. 5 ;" and the bronze medal on Michael Prescot and Arthur Thompson, the two keepers who had had charge of the hippopotamus during the late eventful period.

THE Chancellor of the Exchequer has declined to accede to a representation from British horticulturists to increase the grant of 6,000*l*. in aid of the British contribution to the Vienna Exhibition of next year.

A SUM of 500*l*. having been placed at the disposal of the Council of the Society of Arts, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer prizes, including the Society's gold medal and 50*l*., for each of the following objects : —1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall with the least amount of coal answer best for warming and ventilating a room. 2. For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall with the least amount of coal best answer for cooking food, combined with warming and ventilating the room. 3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room. 4. For the best new and improved system of apparatus which shall by means of gas, be best adapted for cooking, combined with warming and ventilating the room. 5. For any new and improved system or arrangements, not included in the foregoing, which shall efficiently and economically meet domestic requirements.

THE Council of the Society of Arts have resolved to offer the Society's gold medal to that manufacturer who shall produce and send to the London International Exhibition of 1873 the best specimens of steel, suitable for affording increased security in the construction of locomotive and marine engines and boilers, and for other engineering purposes.

MR. JAMES MCNAB, Curator of the Royal Botanic Garden, Edinburgh, was unanimously elected President of the Botanical Society at their last meeting, in room of Prof. Wyville Thomson. The Society was founded in 1836, and Mr. McNab is one of the original twenty-one members, only eight of whom are now alive.

AT the suggestion of Mr. Carruthers, the time ot competition for Lord Cathcart's prize for the best essay on the cause of and mode of preventing the potato disease, has been extended to November 1, to give candidates an opportunity for pract ical research on the subject.

MR. EMMANUEL DEUTSCH has obtained six months' leave of absence on account of his health. He intends to spend the time in Egypt.

WE hear that the proprietors of the *Daily Telegraph* have placed an unlimited sum at the disposal of the Society of Biblical Archæology, to enable Mr. Smith, the author of the paper on the Chaldee account of the Deluge, to proceed to the East for the purpose of further investigation among the Assyrian ruins.

WE understand that Mr. Cleminchaw and Mr. Jongstaff, who were placed in the first class in Natural Science at Oxford, and who are mentioned as having been educated at Rugby School, were students in Natural Science at King's College, London.

THE Berlin Geographical Society has opened subscriptions for the contemplated Congo Expedition. Dr. Güssfeld, the glacier explorer, who is to be the leader of the enterprise, has himself contributed nearly 1,000*l.*, and there is every prospect that the full amount necessary will be forthcoming.

MR. EDWARD D. COPE, of the Academy of Sciences, Philadelphia, has just returned to that city from a geological expedition in the territories of Wyoming and Nevada, during which he has explored a large area of Eocene and Cretaceous strata, and made some fine discoveries. Remains of over fifty new Vertebrata have been obtained, amongst which is a new *Dinosaurian* allied to *Cetiosaurus*. Amongst the mammals are some new *Proboscideans*, which appear to have been furnished with horns, and to form a transition towards the *Perissodactyle Ungulates*.

MR. J. P. GASSIOT, F.R.S., has presented to the Royal Institution a marble bust of the late Mrs. Somerville by M'Donald, the sculptor, of Rome.

WE learn from the *British Medical Journal* that Dr. Apjohn of Dublin has been appointed to the Prælectorship of Chemistry in Caius College, Cambridge.

THE Birmingham and Midland Counties branch of the British Medical Association has decided to take steps to form a microscopical section.

THE Clifton College Scientific Society has just issued the third part of its "Transactions," wherein the officers speak favourably, and apparently not without warrant, of the present position of the Society. The list of members is always full and the attendance at the meetings most satisfactory. The amount of practical work done by the members is still a weak point, but signs of improvement are not wanting. Among the papers published in this volume the two which appear to show the largest amount of original observation are both geological—"Aust Cliff," and "The Oolite at Minchinhampton," both by H. Wills, and both illustrated by sections. The museum of the college has acquired many valuable additions during the past year. Altogether, we cannot doubt that the Society is doing a most useful work in fostering a taste for natural science.

THE last part of the Proceedings of the Bath Natural History and Antiquarian Field Club is more concerned with the latter than the former portion of their programme. There are, however, one or two short papers on subjects connected with Natural Science, and an interesting sketch of the biography of early geologists connected with the neighbourhood of Bath, by Mr. W. S. Mitchell. A summary of the Proceedings of the Club for the year 1871-72 is appended, together with the Address of the President, the Rev. Leonard Blomefield (late Jenyns) after the anniversary dinner.

WE have before us the eleventh Annual Report of the Lower Mosely Street (Manchester) Schools Natural History Society. The meetings of the society have been held weekly throughout the year. The number of communications to the Society during the year in the form of lectures and papers has been twenty-three, on a great variety of subjects in the various branches of natural science. All of them were well illustrated, some by means of the microscope, others by diagrams and objects combined. We cannot too highly commend the labours of a society doing its work in this quiet and unobtrusive way in the midst of one of our most crowded cities.

WE have received from the Hydrographer to the Admiralty a series of Physical Charts of the Pacific, Atlantic, and Indian Oceans.

THE scheme for establishing a Technical College in Glasgow is now assuming a somewhat tangible shape. A subscription list has just been issued, in which we find that thirty subscribers have among themselves contributed no less than 11,050*l.* Subscriptions of 1,000*l.* each have been given by the firm of Robert Napier and Sons, the eminent shipbuilders and engineers; Mr. W. Mongomerie Neilson, of the Hyde Park locomotive works, and son of the inventor of the hot-blast; and Mr. John Tennant, the head of one of the oldest and largest chemical firms in the world. Of the thirty subscribers, twenty-two are members of the general Committee. It is proposed, when 20,000*l.* is subscribed, to begin the actual organisation of the Technical College, establishing, in the first instance, chairs for—(1) naval architecture and marine mechanical engineering; (2) the theory and practice of weaving; and (3) the theory and practice of dyeing and printing on textile fabrics.

WE learn from the San Francisco *Morning Bulletin* that there is in course of construction at Woodward's Gardens a salt-water aquarium of modest dimensions, yet designed to be complete in all its parts. A year ago the proprietor of the Gardens sent Charles Schumann to Europe to examine the sea aquaria of Paris and other cities. After much time spent in investigation, Mr. Schumann determined to draw his plans on the model of the Berlin aquaria, though on a smaller scale. The building now in progress is the result. The aquarium will be mainly under the surface of the ground, in order to secure an even temperature. There are fifteen tanks in all, one of which is for freshwater specimens. The tanks vary in size from 300 to 1,000 gallons capacity, the largest containing eight thousand pounds of water. Several of the tanks are fitted up with sea-worn rocks obtained at the cliff-house, and some at Santa Cruz. There will be room for marine plants, shells, corals, &c. It is the intention to obtain deep-sea animals and other rare denizens of the deep, with a live shark or two, a devil fish, &c.

DR. NATHANIEL HAYCROFT has reprinted his inaugural address, delivered before the Leicester Literary and Philosophical Society, on the Limits of Scientific Inquiry; and we find also the abstract of a paper read at the last meeting of the Natural Science Section of the Sheffield Philosophical Society by the President, Dr. Hime, on Phenomena and Forces, both rather extensive subjects for an hour's discourse.

THE following is from the *Journal of the Society of Telegraph Engineers*:—"Thanks to the noble exertions of the illustrious president of the Italian Geographical Society, the idea of an Arctic expedition under the Italian flag is gradually working its way into their minds. Funds have been offered, and the prospect is brightening that the old voyage of the *Zeni*, though the first, will not be the last of the Italian Arctic expeditions." The same journal says that Signor Guido Cora announces his intention of editing an Italian geographical periodical, to be entitled *Kosmos*, the first number of which is to appear on January 1, 1873.

THE following is from the *School Board Chronicle*:—"New York has 101,883 scholars to rather over a million of inhabitants; these children receive their instruction from 2,765 masters (*i.e.*, one teacher to every thirty-six pupils); the educational budget amounts to very nearly 700,000*l.*, or 7*l.* for each child. In England, in one year, 35,999 men and 49,522 women were found unable to sign the marriage register."

NUMEROUS seals, very rare in these waters, are making their appearance at the mouth of Holy Loch and in Loch Long, in the Frith of Clyde.

WE learn from the *American Agriculturalist* that it has been finally decided to locate the arboretum, for which a large bequest was made to the Harvard University by Mr. Arnold, of New Bedford, on a farm, about ten miles south of Boston, where the School of Agriculture already exists. The details of the work are to be under the immediate control of Prof. Sargent, who is eminently well qualified for it. He proposes to lay out the ground (137 acres of well-diversified land) as a natural park, with drives and walks tastefully arranged, and leading from one family to another, in scientific order, of all the trees and shrubs hardy in that climate.

A "CENTENNIAL Commission" has been appointed by the American Congress to mature a scheme for the celebration of the nation's hundredth anniversary in 1876, by holding an International Exposition in Philadelphia, which shall be "the grandest the world has ever seen." The sum required to conduct it properly is estimated at $10,000,000, and each State is called upon to subscribe its share of the amount as definitely fixed by the Commission. At a recent public meeting in Philadelphia $100,000 worth of stock was taken in fifteen minutes.

THE American Palestine Exploration Society, of which we have already made mention in our columns, is about sending off an expedition for the purpose of carrying out the objects of that body. According to the *Independent*, it is to be under the direction of Lieut. E. Steever, U.S.A., who will have special charge of the topographical survey, and of the preparation of a reliable map. He will be accompanied by Prof. John A. Payne, late of Robert College, Constantinople, who will superintend the archæological department, and make what collections he can in natural history and geology; but, being himself especially a botanist, he will devote his principal attention to that branch. Mr. Van Dyke and other gentlemen will probably accompany the party to the field, and among them will be an artist of considerable reputation. This labour is one, of course, that will require some time for its completion; and, according to the *Independent*, at least six years will be necessary to accomplish its object thoroughly, even allowing for the assistance of a British society (organised for a similar purpose) in doing its share of the work.

THE DIOSMOTIC PROPERTIES OF COLLOIDS*

DUTROCHET, in his researches on osmose, examined the properties of certain organic non-crystallisable substances (later named colloids by Graham).

Comparing the colloids gelatin, gum-arabic, and albumen (from hens' eggs) with cane sugar, he thus expressed numerically the endosmotic power of these substances:—Gelatin, 3; gum-arabic, 5·17; sugar, 11; albumen, 12. Thus the endosmotic force attributed to the colloids was considerable, in the case of albumen exceeding that of sugar.

These results must, however, be considered in great measure fallacious, as, while the specific gravities of the solutions were equal, (1·01) their degrees of concentration were very different. The solutions of gelatin and albumen contained 4·1 per cent. of these substances, while the sugar solution scarcely contained 2·5 per cent. of sugar. On this ground the sugar must be ranked above the colloids.

There is another circumstance to be considered. Dutrochet used the colloids in their natural state (common gum-arabic and albumen direct from the egg), and in this form they contain over 3 per cent. of mineral substances, chiefly salts of lime and potash. Since Graham pointed out the great difference between crystalloids and colloids, as regards diffusion in water and passage through a membrane, it was to be expected that the presence of crystalloids in the colloidal substance would considerably mask the diosmotic properties of the latter. In the writer's experiments he employed colloids freed from mineral substances, comparing their diosmotic properties with those of the same substances in the natural state. Contrary to the generally received opinion that these substances have a high endosmotic power, he found that this is not the case, though certain variations are met with, which will presently be explained.

Solutions of pure colloids showed, when of moderate concentration, a very weak endosmose. The properties of the membrane, however, distinctly affect the results. Animal bladder, parchment, and artificial cellulose, are very near one another in this respect. With the first two the concentration of an albumen or arabin solution might be raised to about 10 per cent. without any perceptible increase of volume in the solution, at the expense of the pure water. Tannin gave a slight endosmose; a 10 per cent. solution in 24 hours received 1·0 cc. water (the membrane being parchment). The degree of concentration now given may be considered about the limit within which, for these substances, and with the membranes named, no addition of water takes place. With the artificial cellulose, the limit seems to be somewhat lower, for a 9 per cent. arabin solution gave (with it) a perceptible, though very weak endosmose (about 0·45 c c) in 24 hours, and a tannin solution 7 per cent. increased in volume 0·8 cc. in the same time.

On comparing with colloids in the impure state, it was found that while a 10 per cent. arabin solution received hardly any water through the parchment, (about 0·5 cc.), an equally concentrated solution of common gum-arabic increased in volume, in the same circumstances, about 2·55 cc.

When a pyroxilin membrane was used with the pure colloids, the endosmotic action was considerably greater than that which took place in the other membranes. Thus with pyroxilin a 10 per cent. solution of albumen increased 9·0 cc. in volume, and an equally concentrated arabin solution 14·0 cc.; while, in the same time, when the membrane was animal bladder or parchment, the endosmose was hardly perceptible (0·5 cc.). This shows that the weak endosmotic action of colloids, when particular membranes are used, is not to be attributed to their weak attraction for water, but rather to the properties of the membrane. And in the above case it appears that the different behaviour of the membranes corresponds to their different absorptivity for water. Especially does this appear from the fact that a very different endosmose takes place with one and the same membrane, according as it is employed as pyroxilin, or after its reduction as cellulose (by a process described in a previous part of the paper). Thus a 7 per cent. arabin solution received, through a pyroxilin membrane, 5·3 cc. water; when the membrane was reduced, an equally concentrated solution showed no endosmose, and a 9 per cent. solution of the same substance only received about 0·45 cc. water.

For substances largely soluble in water, the attraction of their particles to water may have wide limits of variation, according to the measure of concentration. Those substances, on the other hand, which can only receive limited quantities of water, as *e.g.* cellulose, are, when brought into contact with water, soon saturated, and have thereafter an unvarying attraction for water. When, therefore, an arabin or albumen solution of certain concentration receives no water through the animal bladder or parchment, this only shows that with the concentration given, these colloids have less attraction for water than the membranes have. If, however, the concentration is raised above a certain limit, the attraction of the membrane for water is overcome, and endosmose occurs. This limit, the same membrane being used for different colloids, must evidently depend on the attraction of these for water. My experiments show that in equally concentrated solutions tannin gives the greatest endosmotic action; then follows arabin, and next albumen, an order agreeing with the stability of these substances in their aqueous solutions, which may in general be taken as a measure of their affinity for water. From membranes like pyroxilin, in which the water is held with little force, it can be withdrawn by weak colloid solutions; hence a much greater endosmotic effect is seen in this case.

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* Abstract of part of a paper in "Poggendorff's Annalen," by J. Baranetzky.

In further support of the explanation now given, we have the fact that with membranous substances chemically the same the colloid solutions show greater endosmotic force the less dense the membrane is, *i.e.* the wider its water-filled interstices are. Indeed the attraction of water to the substance of the membrane must diminsh greatly with the distance.

The particles of water in the central parts of the interstices will be less attracted the wider these interstices. This may be illustrated by using two pyroxilin membranes of different densities. Thus, employing a 7 per cent. arabin solution, it was found that in 24 hours 5·3 cc. water passed through the denser membrane, whereas 9·5 cc. passed through the other. Similarly with two pieces of parchment from different manufacturers, a 10 per cent. arabin solution gave in one case 0·5 cc., and the other 1·6 cc. endosmose, and after expanding in all directions, the more compact of the two, an equally concentrated arabin solution, gave, with it, 3·5 cc. endosmose.

If we consider the case of the impure colloids, it is not easy to see in what way the presence of so small a quantity of crystalloid substance increases the endosmotic action so greatly; for the same quantity of crystalloid, taken by itself, does not give the weakest perceptible endosmose. In the converse case, addition of a small quantity of colloid to a crystalloid solution, the endosmose of the latter is increased also.

Fick observed that endosmotic equivalents must be higher the more mobile the particles of the salt solution employed. The presence of colloids in the solutions makes the latter denser; when, however, a crystalline substance is dissolved in a dense fluid, its particles must be less mobile than in solution with pure water; and this is the most probable explanation of the action of colloids in exalting the endosmotic force of crystalloid substances.

It is, however, found that when a colloid solution is submitted to diosmose of water containing even a small quantity of a crystalline salt, instead of to pure water, the endosmose of the colloid is considerably diminished.

The action of the crystalloid in this case cannot be attributed to an endosmotic current originated by it; none of the salt solutions that were employed showed, in direct experiment with water, the slightest increase of volume at the cost of the water. The phenomenon is one requiring further experiment in order to arrive at its explanation.

A. B. M.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 10, 1872.—This number commences with a paper by Dr. Herwig on the expansion relations of superheated vapours. In his experiments he used a U-tube, one limb of which contained the vapour and the other dry air, these being separated by a little mercury, and the instrument being heated in a bath. The general result arrived at is that, at certain low pressures, with constant volume, superheated vapour has a smaller coefficient of expansion than that of perfect gases (viz. 0·003663). The numerical results for sulphide of carbon, chloroform, and alcohol, are tabulated.—J. Baranetzky communicates a long and interesting paper of researches in diosmosis.[*] Sketching the history of the subject, he points out several defects in previous investigations. Nearly all the experimenters from Vierodt's time have sought to determine the endosmotic equivalents of salts, and the results are very discordant. The diosmotic properties of colloids have been imperfectly studied and misconceived. The membranes employed have mostly been animal, and the influence of the nature of the membrane is a question which, M. Baranetsky thinks, has hardly been touched. Having directed his experiments to some of these points, he shows the influence of various kinds of membrane (parchment, bladder, artificial cellulose, pyroxilin), and various thicknesses of membrane on the endosmose of various salts. As to the colloids, he found that, when of moderate concentration (say 10 p. c.) *and freed from mineral substances*, they showed little or no endosmose; and for the same degree of concentration, pyroxilin and cellulose gave more endosmose than animal membranes. The writer further discusses the influence of adhesion, and concludes by applying his observations to animal and plant life.—G. Vom Rath gives his concluding mineralogical paper, treating chiefly of the chemical composition of some Vesuvian products; and this is followed by an account of some studies in micro-mineralogy (last of a series also) by Dr. V. Lasaulx.—In a note by H. F. Weber, on the specific heat of carbon. the discrepancy of various observations is attributed to the fact that the specific heat (in this case) varies with the temperature, being tripled, in the case of the diamond, between 0° and 200°.

THE *Lens* for July 1872, contains—"Algæ Rhodiaceæ, a list of Rhode Island Algæ," by Stephen T. Olney, including the Desmidiaceæ and Diatomaceæ.—"The Cell," by J. N. Danforth, M.D., commences an examination of the theories of cell development.—"The Flora of Chicago and its vicinity," by H. H. Babcock, is continued from the previous numbers.—"The Markings of the Test Podura Scale," by F. W. S. Arnold, M.D., accompanied by an Albert-type plate from negatives produced by the author. It contributes very little to the controversy. "A Conspectus of the Families and Genera of the Diatomaceæ," by Prof. H. L. Smith, is continued, with an "Index to Synonym Register."—"Microscopical Memoranda for the use of Practitioners of Medicine," by Dr. J. J. Woodward, is also continued from the previous number.—"Fungi in Cows' Milk," by Prof. James Law. In this case the fungi are presumed to have originated from impure water supplied to the herd.—"Hepatica," by H. H. Babcock, and "Puccinea on Paper," by Thomas Taylor, are short papers; as are also those by F. W. S. Arnold, on "Hæmatoxylin as a staining material for animal tissues;" and A. Prazmowski, on "Draw-tubes *v.* deep eyepieces."

IN No. 1 of the *Proceedings of the Swedish Academy of Sciences* for the present year (Ofversigt af Kongl, Vetenskaps Akademiens Förhandlingar, Arg. 29, No. 1) M. A. E. Förnebohm gives a geognostic section of the central chain of Scandinavia between Ostersund on the east and Levanger on the west. The section includes primitive Cambrian and Silurian rocks, and the author remarks that the most striking point in it is, that fossiliferous Silurian rocks are covered in the Areskuta by two great schistose non-fossiliferous formations resembling the typical rocks of what he calls the primitive formation (gneiss, hornblende, schists, &c.). A short summary in French is appended to this paper, which is illustrated with woodcuts and a folding plate.—M. E. Edlund communicates a continuation of his attempt to explain the phenomena of electricity by means of the luminiferous ether.—From M. O. J. Fahræus we have a long series of Latin descriptions of Caffrarian *Longicorn Coleoptera* collected between the years 1838 and 1845 by J. A. Wahlberg. The species here described (58 in number) belong to the divisions *Prionidæ* and *Cerambycidæ*, and include the types of several new genera.—M. H. Gyldén gives formulæ and tables for the calculation of the distance at which lighthouses may be visible.—M. Hjalmar Stolpe communicates the results of natural history and archæological investigations in Björkö and Mälaren.—The tendency of the trichomata of plants to changes of form is the subject of a paper by M. P. G. E. Theorin, in which the author describes and figures certain forms of those organs occurring in the common yellow water-lily.—M. Gustaf Eisen notices some Arctic oligochætous annelides, including three species of *Lumbricus* and a *Rhynchelmis* from Newfoundland, and a *Lumbriculus* from Greenland. *Lumbricus puter* (Hoffm.) is briefly described, and *Enchytræus Pagenstecheri* (Ratzel) from Greenland, in more detail, for comparison with a new species, *E. Ratzeli*, from the northern parts of Norway. Figures are given of the characteristic parts of the last two species.

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[*] See ante, p. 152.

SOCIETIES AND ACADEMIES

London

Mathematical Society, Dec. 12.—Dr. Hirst, F.R.S., president, in the chair, Prof Cayley read a paper "On the mechanical description of certain quartic curves by a modified oval chuck," and exhibited the action of the instrument. Mr. S. Roberts spoke on the subject of the paper.—Prof. Cayley then gave an account of his communication "On geodesic lines, especially those of a hyperboloid."—Mr. J. J. Walker made a few remarks on the breaking up of the anharmonic Ratio Sextic—Mr. J. W. L. Glaisher next gave a description, and worked out part, of his paper "On a deduction from Von Stavdt's property of Bernoulli's numbers."—Prof. Clifford read a paper, "Geometry on an Ellipsoid."

Linnean Society, Dec. 5.—Mr. G. Bentham, president, in the chair.—On the skeleton of the *Apteryx*, by Thos. Allis.—On new and rare British Spiders, by the Rev. O. P. Cambridge.

Dec. 19.—Mr. W. G. Smith exhibited a fine specimen of *Batarrea phalloides* (one of four specimens found in the grounds of the Earl of Egmont, near Epsom), and read a brief paper thereon, in which he commented on the great rarity of the plant and the peculiarity of its form. Mr. Smith gave some details of its structure, especially as regards its possession of so-called spiral vessels, and referred to its position among other fungi, especially the genera *Clathrus*, *Phallus*, *Cynophallus*, and *Geaster*, a complete set of drawings of these genera, showing every stage of growth, being exhibited to the meeting.—On the development of the flowers of *Welwitschia mirabilis*, by W. R. M'Nab. These investigations were made on a beautiful series of flowers of both sexes forwarded by Dr. Hooker, whose previous paper was based on the examination only of immature specimens. Prof. M'Nab's conclusions differed in some respects from those of Dr. Hooker. He believes the male and female flowers to be constructed on a different plan. In the female flower the ovule is truly naked, what has been taken by some to be the carpel being in reality the integument of the ovule. In the male flower, on the other hand, the (rudimentary) ovule has a true carpellary coating. In the male flowers, therefore, *Welwitschia* shows a close approximation to Angiosperms. Several other points in the structure and development of this remarkable plant were exhaustively gone into.—On the General Principles of Plant Construction, by Dr. M. T. Masters, F.R.S. The chief objects of this suggestive paper were to attempt to introduce greater exactness into botanical terminology, the definition of parts and organs according to their morphological rather than their external significance, and to frame a classification of the facts of morphology in accordance with our present knowledge of the laws of development.

Geologists' Association, Dec. 6.—The Rev. T. Wiltshire, M.A., president, in the chair.—"On coal seams in the Permian at Ifton, Shrpshire, with remarks on the supposed glacial climate of the Permian period," by D. C. Davies, F.G.S. The author showed the existence of three well-defined and workable seams of coal *above* the red sandstones and marls which are generally held to form the base of the Permian strata. He then proceeded to show the identity of these red beds with similar beds overlying the coal throughout several of the Midland Counties, and with the red sandstones of the North of England, and also that the overlying sandstones, shales, and coals were the equivalent of the magnesian limestones and calcareous conglomerates which occupy the same horizon in widely distant places. After referring to the former probable extension of these beds over a large area, the author pointed out that in the neighbourhood described the gap or break which is usually supposed to occur between the Coal Measures and the Permian was partly, if not quite, bridged over. He also noticed how the different geological formations were dovetailed into each other, the old passing upward into the new, and not divided by sharp, well-defined lines. From the identity of the age of these coal seams with the Permian conglomerate of Alberbury only fifteen miles distant, he questioned the probability of that conglomerate being of glacial origin, since two climates so dissimilar as a glacial one and that in which a carboniferous flora flourished could not exist together within so limited an area. In conclusion, Mr. Davies pointed out the necessity for alterations of the boundaries of the Permian and the coal measures in any future geological maps of the district.—Note "On a well section at Finchley," by Caleb Evans, F.G.S.

Entomological Society, Dec. 2.—Prof. Westwood, F.L.S., president, in the chair.—Prof. Westwood exhibited a drawing of a variety of *Pyrameis cardui* captured many years since on Margate sands.—Mr. Bond exhibited several curious varieties of British Lepidoptera, including a female *Lycæa ægon*, the wings of which on one side were coloured as in the male, *Acronycta megacephala*, &c. He also exhibited *Anomalon fasciatum*, a species of *Ichneumonidæ* new to Britain, bred by Mr. Mitford from the larvæ of a supposed variety of *Lasiocampa trifolii*.—Mr. F. Smith, in answer to a question put to him by Major Mann, as to whether queen-bees sting, stated that he had never been stung by one, and Prof. Westwood said that was also his experience.—Mr. Champion exhibited *Thyamis distinguenda* Rye, and *Lithocaris picea* Kraatz, two species of beetles recently detected in Britain. Mr. Müller read notes on the manner in which the ravages of a species of *Nematus* or *Salix cinerea* are checked by *Picromerus bidens* L.—Mr. Dunning read supplementary notes on the genus *Acentropus*.—Mr. Baly sent the first portion of a catalogue of the phytophagous *Coleoptera* of Japan, partly drawn up from materials collected by Mr. George Lewis.—Mr. F. Bates communicated descriptions of new species of *Tenebrionidæ*.—Mr. R. Trimen sent descriptions of new South African butterflies.

Photographic Society, Dec. 10.—James Glaisher, F.R.S. president, in the chair.—A paper was read on landscape photography by F. C. Earl, in which that gentleman detailed his method of photographing large landscapes. Lenses of different focal length, but covering the same extent of field, were employed in the camera, so that foreground, middle distance, or horizon might be rendered more or less prominent at will.—Mr. J. R. Johnson read a paper on a new actinometer recently invented by Mr. Burton, the translucent films of which were formed by bichromate films, coloured with pure Indian-ink; the scales were arranged in true geometrical progression.—Mr. George Croughton read a paper on mezzotint effects.

Royal Microscopical Society, Dec. 4.—W. Kitchen Parker, F.R.S., president, in the chair. A new form of micro-spectroscope was described by Edward Gayer, Surgeon of H.M. Indian Army. Mr. Gayer claims for his invention the following advantages, more light, more dispersive powers, and the possibility of using it even with high powers.—Dr. Royston Pigott drew attention to a new method of using the micrometer.—The President read a paper "On the Histology and Growth of the Skull of the Tit and Sparrow Hawk."

Edinburgh

Royal Physical Society, Nov. 27.—Mr. Charles Williams Peach, one of the presidents of the society, delivered an opening address, his subject being "The Fossil Flora of the Old Red Sandstone of the North of Scotland." The history of the Old Red sandstone, he said, whether of its rocks, plants, or fishes, was still to be written. Slowly light was breaking in upon the organisms found in the formation; but much inquiry and search required yet to be made before a full catalogue of these could be drawn up. Not long ago it was believed that the only organisms to be found in the Old Red sandstone were of a marine character, such as fucoids, but he ventured to say that the flora of the formation was not so poor as was supposed. He had investigated the Old Red, particularly in the north of Scotland, and found many land plants. They were rarely to be found in beds of limestone, seldom or never in the pavement beds of commerce, but were far from rare in the coarse beds that underlie the last-named. He believed that if these coarse beds were exposed a perfect forest of plants would be discovered. The state of knowledge of the fossilliferous character of the Old Red sandstone stood thus:—In 1844 land plants were *nil*, fucoids abundant; 1849, of land plants, one genus and one species; fucoids as many as you please; 1855, five genera of land plants and five species; fucoids abundant; 1872, thirteen genera and twenty-three species of land plants; sea-weeds *nil*.

Edinburgh Naturalists' Field Club, Nov. 29.—Mr. R. Scott-Skirving, president, in the chair.—The secretary, Mr. J. D. Brown, read the annual report, which stated that during the year the club had had twenty-three excursions. The secretary of the Largo Field Society offered a prize—of fifty mounted specimens of *Musci Fifenses*, to be competed for by ladies present at the club's excursions to Kilconquhar and Elie. This prize was gained by Miss Masson. Two additional prizes were offered by two members of the club, to be competed for by the ladies—one at North

Berwick and the other at Linlithgow. The total membership of the club was seventy-eight, showing an increase of eight over last year.

CAMBRIDGE

Philosophical Society, Nov. 25—On the appearance of an extra digit on the hind limbs and then on both fore and hind limbs in two successive generations, and its bearing on the theory of Pangenesis, by Mr. N. Goodman. A cow had three well-developed toes on each hind limb, besides the two ordinary rudiments. Her calf (by a normal bull) had the same peculiarity. This has two calves (by normal bulls). The first, a cow, had the toes as in the other cases, but rather less developed; the second, a bull, had three toes on all four feet. The writer pointed out that this peculiarity might be explained by (1) atavism, (2) certain modifications of the proliferous function by external causes (3) correlation of growth, supplementing the former. He thought it could not be explained by atavism, nor by the second cause, but by the third, and discussed its bearing on his theory of Pangenesis.—A communication was received from Mr. W. H. Stanley on a Pneumatical design for saving life at sea. The process was by the expansion of condensed air stored in reservoirs.

LEEDS

Naturalists' Field Club and Scientific Association, Nov. 26.—Mr. J. W. Taylor on behalf of Mr. W. Nelson, of Birmingham, read a paper on "The Lymnæidæ of the Birmingham district," giving a catalogue of nineteen species found within five miles of Birmingham, against the twenty-three at present included in the British fauna. He also recorded twenty-four varieties for that district. The absence of the remaining four species was readily accounted for, on the ground either of their extreme rarity, or of their recent introduction into these islands. *Planorbis dilatatus* has recently been imported along with cotton; *Lymnæa involuta* has never been found away from its original locality, Killarney; while *Planorbis lacustris* and *Lymnæa glutinosa* are excessively rare. The following is a list of the nineteen species found within five miles of Birmingham. *Planorbis nitidus*, *P. nautileus*, *P. albus*, *P. glaber*, *P. spirorbis*, *P. vortex*, *P. carinatus*, *P. complanatus*, *P. corneus*, *Physa hypnorum*, *P. fontinalis*, *Lymnæa peregra*, *L. auricularia*, *L. stagnalis*, *L. palustris*, *L. truncatula*, *L. glabra*, *Ancylus fluviatilis*, *A. lacustris*.

RIGA

Society of Naturalists, Jan. 24 (Feb. 5, N.S.)—M. C. Berg noticed the damage done to some peas by the larva of *Endrosis lactella*.—M. Gögginger called attention to a yellow lucerne, identified by him with *Medicago media*, which he found near Hapsal, and recommended for cultivation, especially on account of its deep roots. Dr. Buhse doubted the identification of the plant, and stated that *Medicago media* is a hybrid of *M. sativa* and *falcata*, and that when cultivated it reverts to the type of the former species in a few years.—The aurora of February 4 was referred to by M. Schroeder and Prof. Schell. The former found no traces of polarisation, but in the spectroscope a broad greenish yellow line made its appearance. Prof. Schell's paper included notices of the phenomenon from various sources.

February 7 (19 N.S.)—Dr. Nauck exhibited and described a maximum and minimum thermometer constructed on a new principle. It is a U-shaped tube, having one upright limb terminating in a bulb, and the other bent inwards and then downwards into a large cylindrical portion. The lower part of the U-tube is filled with mercury, and the rest with alcohol, except the bulb of the upright tube, the greater part of which is empty. The floats are of glass, enclosing an iron wire, and are fixed in the tubes by means of bent human hairs.—Dr. Buhse gave a detailed description of the parasitic fungi of infectious diseases, in which he referred to those affecting plants, animals, and man, and especially noticed the relation of *Bacteria* to disease.

February 21 (March 4, N.S.)—M. Schroeder announced that two days previously (March 2, n.s.) he observed a distinct zodiacal-light about 8 o'clock P.M.—M. Frederking read a second part of his memoir on the History of Chemistry, in which he referred first to the discovery of oxygen by Priestley and Scheele, and then passed to the consideration of Lavoisier's labours.

February 28 (March 11, N.S.)—M. H. Westermann reported upon a work by Fechner entitled "Experimental Æsthetics," in which the author endeavours to investigate experimentally the general principles of symmetry. This report presents some curious and interesting points; the questions raised by it were discussed by several of the members present.

GOTTINGEN

Royal Society of Sciences, Aug. 3.—M. G. Meissner communicated a paper by Dr. Hartwig on the passage of substances from the blood of the mother into the fœtus, in which he showed, in opposition to Gusserow, that iodine administered in solution to the parent speedily passes into the fœtus.—M. Felix Kleim presented a contribution towards the interpretation of complex elements in geometry.—M. H. Hübner presented a paper by M. G. Spezia on the determination of iodine in the presence of chlorine, by means of protonitrate of thallium. This process is founded on the fact that whilst chloride of thallium is soluble in a large quantity of water, iodide of thallium is insoluble.—M. Wilhelm Weber communicated a paper by M. E. Riecke on the law of electro-organic reciprocal actions proposed by Helmholtz.—M. Clebsch exhibited and described two models prepared by M. Weiler, and relating to a particular class of surfaces of the third order.

Sept. 18.—M. A. Clebsch read a paper on a new fundamental form of the analytical geometry of planes.

Sept. 25.—M. F. Kohlrausch presented a paper on the electromotive power of very thin strata of gas upon metal plates.

Oct. 9.—M. A. Clebsch communicated a paper by M. A. Mayer on Lie's method of integration of the partial differential equations of the first order.

Oct. 30.—M. A. Clebsch communicated a long contribution by M. Sophus Lie to the theory of partial differential equations of the first order, and on their classification.

Nov. 13.—M. A. Clebsch presented a note by M. H. Grassmann on the theory of curves of the third order.—M. Weber communicated a paper by M. E. Reicke on the magnetisation-function of a sphere of soft iron.—Prof. Henle presented a note by M. Oscar Grimm on the olfactory organ of the sturgeon, in which the author describes certain peculiar cells which occur on the surface of the olfactory grooves.—M. Oscar Grimm also forwarded a note on *Synura uvella* and *Uroglena volvox*, belonging to Häckel's Protistan group of the Catallacta, indicating a probable genetic connection of the Catallacta with the sponges.

VIENNA

Imperial Academy of Sciences, Oct. 10.—The completed MS. of a catalogue of observed Polar lights was forwarded by Dr. Herrmann Fritz of Zürich. Prof. Hlasiwetz communicated a memoir by Dr. F. Hinterberger on excretine. The substance was prepared by the author from fresh human excrement, and found to be free from sulphur and with the formula $C^{20} H^{36} O$. With bromine it forms bibromexcretine, with the formula $C^{20} H^{34} Br^{2} O$.—Dr. Kretschmar presented a memoir on the influence of morphine, and carbonate and sulphate of soda in *diabetes mellitus*. The first-mentioned substance acted beneficially, and reduced the secretion of sugar to zero.—Prof. L. Boltzmann communicated two memoirs, one containing further investigations on the heat-equilibrium among gaseous molecules, the other an experimental investigation on the behaviour of non-conducting bodies under the influence of electrical forces.

October 17.—M. Otto Hermann presented a memoir entitled "The Noble Siebenburgian Horse," intended to correct statements in Dr. L. J. Fitzinger's essay on the origin of the domestic horse and its races.—Prof. E. Mach, of Prague, communicated a memoir on the stroboscopic determination of musical notes. His stroboscopic scale is a uniformly rotating white cylinder covered with black longitudinal streaks, the closeness and number of which rapidly increases from one end of the cylinder to the other. This is observed through radiating fissures in a paper disc attached to the axis of the sirène, and the streaks are always seen simple at the spot where they pass before the eye in the vibration-number of the sirène.—The same author forwarded two papers prepared by him in conjunction with Dr. J. Kessel. In the first of these, on the function of the tympanic cavity and of the eustachian tube, the authors show by experiment, not only that the tuba is usually closed, but that this closure is necessary for the production of effective vibrations of the tympanic membrane. In the second they treat of the accommodation of the ear, and show that, although alterations of the tension of the *tensor tympani* may cause a limited accommodation, such alterations do not occur in the living ear during hearing and listening.

October 24.—Prof. L. Gegenbaur, of Krems, communicated a memoir entitled "Integral Expressions for the Functions Y^m_n." Dr. Peyritsch presented a memoir on Peloric formations, in which he described the types of pelorism in the Labiatæ, Verbenaceæ, Scrophulariaceæ, and Ranunculaceæ, and endeavoured to show the probability that in the Labiatæ we have to do with a quaternary and not with a quinary type.

PHILADELPHIA

Academy of Natural Sciences, May 28.—Professor Cope exhibited some vertebræ of a Plesiosauroid reptile and also those of a smaller species, probably a *Clidastes* which were found in close proximity near Sheridan, Kansas, by Mr. Joseph Savage, of Leavenworth. According to this gentleman, the vertebral column of the *Clidastes* was found immediately below that of the Plesiosauroid and in a reversed position, as though it had been swallowed by the latter or larger reptile. The largest vertebræ of the *Clidastes* were about three-quarters the length and one-fourth the diameter of those of the Plesiosauroid, and the animal must have furnished a large, or at least a long, mouthful for its captor. The bones of the *Clidastes* were not in good condition, but resembled those of *C. cineriarum* Cope, though smaller. The Plesiosauroid was new to science, being the third species discovered in the Cretaceous of the Niobrara group. Specifically it was nearest to the *Elasmosaurus platyurus* Cope, but was readily distinguished by the relatively shorter cervical vertebræ, and the regular acute ridges on the exterior surfaces near the margin of the articular faces, as well as the less contracted form of all the vertebral centra. Associated with these remains were those of a turtle of the size of some of the large *Chelonidæ* of recent seas. The only portions were the scapulo-procoracoid, the coracoid, and the mandible nearly complete. The general characters of this form were thought to agree with *Cynocercus* Cope, though the individual was larger than that on which the *C. incisus* was established.

June 4.—Mr. Thomas Meehan presented some specimens of the common asparagus, and remarked that in consequence of observing last year so many plants that had evidently flowered producing no seeds, he had this year examined them in a flowering condition and found them perfectly diœcious. Imperfect stamens existed in the female flowers, but they were never polleniferous. An occasional gynœcium in the male flower would make a weak attempt to produce a pistil, but no polleniferous flower ever produces a fruit. There was a great difference in the form of the male and female flowers. The former were double the length of the latter, and nearly cylindrical, while the female flower was rather campanulate. Other observers had nearly made the discovery of division in this plant. The old "English Botany" of Smith gave it the character of being occasionally imperfect, and the authors of "Deutchland's Flora" considered it as occasionally polygamous. But Mr. Meehan was satisfied from a half day's investigation among many plants that in this region at least the asparagus is never perfect, but truly diœcious. He had observed another matter, small, but which might be of importance to systematic botanists, as well as to those engaged in evolutionary studies. One flower had a quadrifid stigma, and a four-celled ovary. The trinate type, or its multiple, is so closely associated with the endogenous structure, that he considered this circumstance particularly worthy of note. The male flowers seem very attractive to insects, various kinds of which seem to feed on the pollen. The honey bee was a frequent visitor. None seemed to be attracted to the female flowers. In the division into separate sexes the plant had gained nothing in the way of aid by insect fertilisation. Fertilisation seemed wholly accomplished by the wind. The male flowers are produced in much greater abundance than the female ones. Mr. Meehan added that this discovery had a more than usual practical importance. Many attempts had been made to improve the asparagus, as garden vegetables and the farm cereals had been improved; but it had often been questioned whether these improved forms would reproduce themselves from seed as other garden varieties did. The tendency of thought the few past years had been in the direction of the belief that permanent varieties could be raised, and several improved kinds had been sent out by seedsmen, and were popular to a considerable extent. He said he had himself inclined to this opinion; but this discovery of complete diœcism in asparagus, whereby two distinct individual forms were required to produce seed, rendered a true reproduction of one original parent impossible, as the progeny must necessarily partake of both forms.

"On the Fishes of the Ambyiacu River," by Edward D. Cope. The collection on which the present examination is based was made by our correspondent at Pebas, John Hauxwell. It embraces fishes of the small streams tributary to the Ambyiacu, as well as those of the river itself. The Ambyiacu is an inconsiderable river, which empties into the Amazon near to Pebas, in Eastern Equador, some distance east of the Napo. The results of the examination will be mentioned at the close of the list. As was to have been supposed, it consists almost exclusively of representatives of the three great families which abound in the neotropical region; the *Chromididæ*, representing Physoclystous fishes, and the *Characinidæ* and *Siluridæ*, representing the Physostomi. The number of new species, 45 in a total of 74, constitutes a considerable addition to ichthyology, especially as the number of new generic forms is also rather large. The author adds a list of the species obtained by Robert Perkins, of Wilmington, Delaware, on a trip between the mouth of the Rio Negro and the Peruvian Amazon or Ucayale River. There are several interesting novelties in this collection, but their special localities are, unfortunately, not preserved. The specimens generally were large, and in fine condition.

BOOKS RECEIVED

ENGLISH.—A Budget of Paradoxes: A. De Morgan (Longmans).—Physics and Politics: W. Bagehot (H. S. King and Co).—Grotesque Animals: E. W. Cooke (Longmans).—Owens College Junior Course of Practical Chemistry: Roscoe and Jones (Macmillan).—The Hygiene of Air and Water: W. Procter (Hardwicke).

PAMPHLETS RECEIVED

ENGLISH.—The General Glaciation of Jar-Connaught and its Neighbourhood: Kinahan and Close.—Proceedings of the Geologists' Association, Vol. ii., No. 7.—Razi: W. Soleman.—Ninth Report of the Belfast Naturalists' Field Club.—The Curability of Cancer, 2nd edition.—Introductory Lecture on Geology: E. Wilson.—The Examination Questions in Geology, with answers.—Transactions of the Institute of Engineers.—Annual Report of Vigilance Association.—A Catalogue of a Collection of Models of Ruled Surfaces, constructed by M. F. de Lagrange.—Journal of Anatomy and Physiology, No. 2.—Weather Report of the Meteorological Office, January–March, 1872.—Transactions of the Clifton College Scientific Society, Part 3.—Journal of the Society of Telegraphic Engineers, No. 1.—Report of the Lower Mosely Street School Natural History Society.—Ocean Highways, Parts 1, 2.—A Table of the relative value of different Articles of Food: C. Ekin.—The Advantages of Gas for cooking and heating: M. Ohren.—Twelve Months' Experience with the A.B.C. Process of Purifying Sewage: W. Crookes.—Provident Knowledge Papers, Nos. 1-12.

AMERICAN AND COLONIAL.—Canadian Naturalist, vol. iv., Nos. 9-10.—New Remedies: H. J. Wood, vol. ii., No. 2.—The Birds of Florida: C. J. Maynard, No. 1.—Proceedings of the American Philosophical Society, January-June, 1871.—Deductive and Inductive Training: B. Silliman.—The Australian Mechanic, Nos. 8 and 9.—Indiana Journal of Medicine for September.—Lippincott's Magazine for November.—Proceedings of the Asiatic Society of Bengal for August.

FOREIGN.—Sitzungsb. der geologischen Reichsanstalt zu Wien. No. 13.—Zeitschrift für Meteorologie, Nos. 20-23.—Zeitschrift für Ethnologie, No. 21.—Le Physiometre: P. Harting.—Ofversigt af kongl. Vetenskaps Akad. Forhandlinger.—Bulletin de l'Acadèmie Royale de Belgique, Nos. 9 and 10. Sitzungsb. der k. k. Akad der Wiss. zu Wien, Nos. 24, 25.—Bulletin de la Société de Geographie de Paris, September.

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ERRATA.—No. 159, p. 28, col. 1, line 8 from bottom, for "microscope" read "spectroscope;" col. 2, lines 16-19 from bottom. for "an absolute" read "one, absolute," and for "impossible" read "improbable."

NATURE

THURSDAY, JANUARY 2, 1873

THE GOVERNMENT AND THE ARCTIC EXPEDITION

THE Arctic Expedition is undoubtedly the question of the day; or, seeing that the wheels of the gods have brought us to the commencement of another annual round, it may be really called the question of the year—that is, of the coming one. We may as well confess at once that we consider it quite worth all the attention it is likely to receive, either at the hands of Her Majesty's Ministers or from the public at large.

It is understood that the Government are at the present moment considering their decision, and it is because this is so that we venture to return to the subject, as there is an idea that the matter has not been put before the Government in the strong manner that it might have been; and the idea is true to a certain extent. But the blame, if any blame there be, attaches more to our scientific system, or rather our want of all system, than to any individuals. No doubt the Royal Society should have had a little more, and the Geographical Society a little less to say at the deputation that waited upon the Government, because we believe that the time has come when both Ministers and people will demand the widest possible basis of research for such an expedition; and that the widest possible basis was not put forward has since been clearly shown by Prof. Balfour Stewart, who has written to the *Times* on the subject. His letter is so important that we give it almost *in extenso*. He writes:—

"We have pursued terrestrial meteorology and magnetism now for some time, but until lately we have been rewarded with little apparent success. We are at last, however, beginning to understand the great importance of these studies, and to see the true path in which they ought to be pursued.

"Proofs of an intimate and mysterious connection between the sun and the earth are rapidly accumulating from various quarters, and the latest instance is one which is surely well worth the attention of all practical men.

"I allude to the discovery by Mr. Charles Meldrum, of Mauritius, that the years when most spots are observed on the sun's surface are also those of most cyclones in the Indian Ocean. Furthermore, a similar connection between the state of the sun's surface and the magnetism of the earth was noticed twenty years ago by Sir Edward Sabine, the late president of the Royal Society.

"Now, surely we ought to inquire into the nature of this mysterious connection, and, if necessary, we ought to spend both means and trouble in the pursuit of such an inquiry?

"What, then, ought to be done? The line of action is surely that recently suggested by Mr. Norman Lockyer. We ought, in the first instance, to scrutinise the sun's surface with all the appliances we can command, with the view of recording the meteorological changes which are there occurring; and in the next instance we ought to do the same with regard to our own earth. To do the first it will be necessary to establish a proper physical observatory; and to do the second *it is essential that we should become better acquainted with the less frequented regions of our globe, which are in many respects the most important. We must especially greatly extend our knowledge of the northern regions, and not of those alone but of the less frequented oceanic regions also.*

"Now, these are objects which can only be accomplished by means at the disposal of Government; for it will be in vain to expect whalers to supply us with the knowledge we desire of these northern regions, and it will be equally in vain to expect merchantmen to cruise about in the less frequented oceanic latitudes in order to increase our acquaintance with their meteorology.

"We have before us the splendid possibility of predicting the nature of seasons; but surely we cannot expect that Nature, who is usually so reticent, will disclose her secrets to a nation or a race who will not take reasonable trouble to complete their knowledge of the physics of the earth?"

Now there is no man of science who will gainsay these remarks coming from so distinguished an authority; and it is quite obvious that if the promoters of the expedition had taken a little more trouble and given a little more publicity to their action, the deputation might have been able to enforce its main arguments by this and other additional "reasons" given by other eminent men of science. Before it is too late, then, and another year is lost, it is to be hoped that the views so ably expressed by Dr. Stewart and held by all who have studied the subject in which he is such an acknowledged master, will be placed before the Government in the most forcible manner possible. The sun cycle to which he refers and which we now know governs cyclones and rainfall in certain parts of the earth, may it not also have something to say to the very passage to the Pole itself? May not the rainy mild seasons, which in the northern temperate zone, have more than once, to say the least, followed the sun-spot maximum, influence the dense masses of polar ice and make navigation more easy? If no one can answer this question, we have in this point alone a sufficient "reason" for undertaking the expedition; while the study of the whole phenomena including the spectrum of the aurora would furnish another, if the mere number of questions were to have weight; and it is curious to notice, that while we remain so ignorant of the nature of whole ranges of polar phenomena in the case of our own planet, the solar polar phenomena have recently been investigated by Prof. Respighi, with marvellous success, by means of the new method.

Sooner or later the polar phenomena of the earth must be studied, and their variations laid down in curves. Modern science demands this, and every year now lost it may take ten to recover. The question is, is England to have a hand in this matter? It is not a question between A's or B's pet theory of getting to the Pole. Will the Government refuse the expedition, now that Admiral Richards, the distinguished Hydrographer of the Admiralty, an officer in whose hands we may with safety leave the claims of cosmical science, has volunteered to command it? In the centuries to come, it will be told how England, in 1870 and 1871, sent out expeditions to observe eclipses of the sun, how in 1872 she sent out the *Challenger*, how in 1874 she sent out expeditions to observe the Transit of Venus. Why, then, should 1873 not be thus distinguished? We firmly believe that the Government have obtained a firmer hold upon the best side of Englishmen by their aid to these scientific expeditions than by all their merely political measures; and surely a universal approval, separated as far as possible from a party feeling, is the best thing Government can strive to obtain.

We believe a statement that the Government has refused the expedition will be received with universal disappointment by every class of Englishmen, to whom the memories which dwell round the name of Captain Cook and a whole navy of Arctic explorers in the past are very dear and a source of pardonable pride.

THE PROGRESS OF NATURAL SCIENCE DURING THE LAST TWENTY-FIVE YEARS

II.

DURING the last quarter of a century, the history of the formation of our earth has assumed a new aspect. When the *Cosmos* appeared, the opinion prevailed that our earth, once a globe of liquid fire, became covered with a crust of congealed scoriæ, on which, by-and-by, the first animal and plant life made its appearance; after an almost infinite length of time, during which the Silurian, Devonian, Carboniferous, and Permian strata were deposited, a terrible catastrophe, affecting simultaneously the whole earth, so completely destroyed the first palæozoic life, that not a single species survived the universal devastation. Upon the lifeless expanse, it was supposed, appeared then, forming the Secondary Fauna and Flora, entirely unconnected with and different from the extinguished one, until after frequent repetitions of the same process at longer or shorter intervals, man made his appearance, and along with him all existing plants and animals: with him begins the Historical Period, whose duration has not exceeded 6,000 years. The causes of these world-wide revolutions Geology sought in the violent reaction of the molten interior against the once extremely slender crust.

In opposition to these views, the opinion peculiarly associated with the name of Lyell has made way, that no violent revolutions, returning at intervals, destroyed the external structure of the earth and all the life it sustained, but that all changes even in the earliest times affected only the earth's surface, and that these could only be the results of the same powers of nature which are actively at work on the earth at the present time; and that moreover, the gradual, but ever active powers of water, of air, and of chemical change, have perhaps had a greater share in accomplishing these transformations, than the fierce heat of subterranean masses of lava. The explorers of the buried remains of plants and animals show it to be impossible that all life in those geological formations could have been destroyed simultaneously, for many species are common at several stages; in particular many existing animals and plants reach far back into the primitive world. Man himself could be shown to have been contemporary with many extinct species of plants and animals, and therefore his age on the earth must be extended back to an indefinite period. Man was witness to that inundation which buried the plains of the old and the new world under the waves of the sea of ice. Even in the immediately preceding period, when the subtropical elephant, rhinoceros, and hippopotamus disported themselves in the lignite woods of Middle Europe, have traces of mankind been found. Only in the most recent times has a foundation been laid for the pre-historic records of mankind, by means of which we may be able to obtain a knowledge of the state of civilisation, weapons, implements, and dwellings of that primitive race.

No book of recent times, Dr. Cohn thinks, has influenced to such an extent the aspects of modern natural science, as Charles Darwin's work "On the Origin of Species," the first edition of which appeared in 1859. For even to so late a period, was the immutability of species believed in; so long was it accepted as indubitable that all the characteristics which belong to any species of plants and animals were transmitted unaltered through all generations, and were under no circumstances changeable; so long did the appearance of new fauna and flora remain one of the impenetrable mysteries of science. He who would not believe that new species of animals and plants, from the yeast-fungus to the mammalia, had been crystallised parentless out of transformed materials was shut up to the belief that in primeval time an omnipotent act of creation, or, as it may be otherwise expressed, a power of nature at present utterly unknown, interfered with the regular progress of the world's development; yea, according to the researches of D'Orbigny and Elie de Beaumont, twenty-seven different acts of creation must have followed each other previous to the appearance of man—but after that, no more. It was Darwin who lifted natural science out of this dilemma, by advancing the doctrine that the animals and plants of the late geological eras no more appeared all at once upon the scene, than those of the preceding epochs simultaneously and suddenly disappeared; on the contrary, these are the direct descendants of former species, which gradually in the course of an exceedingly long period, through adaptation to altered conditions of life, through the struggle for existence, through natural and sexual selection have been changed into the new species. Professor Cohn does not doubt but that Darwin and his school may have over-estimated the reach of the explanations given by him to account for the transmutation of species, and especially the importance of natural and sexual selection, but the fundamental fact has been established, and will remain so for all future time. This fact is that the collective life of the earth, from the beginning even until now, and from the fungus-cell up to man, represent a single series which has never once been broken, whose members through direct propagation have proceeded out of each other, and in the course of a vast period have been developed into manifold and, on the whole, perfect forms.

The sciences which are concerned with life have during late years been cultivated on all sides; even in earlier years Cuvier and Jussieu had done as much for zoology and botany as the state of discovery in their time permitted, but since 1858 the boundaries of both kingdoms have been widely extended by the labours of Carpenter, Huxley, and Pourtalès.

After referring to the researches of Goethe in the last century, and those of Bauer and of Johannes Müller in the present, in reference to the physiology of plants and animals, Prof. Cohn says it was only in our own time, and first in 1843 in Schleiden's "Grundzügen der Wissenschaftlichen Botanik," that the new principle was followed out; the principle, namely, that all vegetable phenomena and all the various forms of plants proceed from the life and the development of their cells. After Schwann discovered that animal bodies also were built up from an analogous cell, mainly by Virchow was then developed from this principle the modern cellular physiology and pathology which traces the condition both of healthy and diseased men and animals back to the life-function of their cells. But, as the lecturer says, to attempt to follow out the advances made by science in these directions during the last twenty-five years would require a large volume, and cannot be done in the space of a lecture or an article.

Even the cell itself has been changed. Until Schleiden's time it was a little bleb filled with fluid ; we now regard it as a soft glutinous body constructed out of the albuminous protoplasm first distinguished by Mohl in 1845, and which is covered with a cellular integument, as the oyster is with its cell. After waxing eloquent over the cell as an entity, an "ego" by itself, and its relations to the outer world, Prof. Cohn says that science now teaches us that there is only one life and one cell, the cell of plants and of animals being essentially the same. The most highly-developed animal differs from the simplest plant only in the number and greater development of the matter composing the cells, but above all, to the more complete elaboration (*Arbeitstheilung*), and the stricter subordination of the separate cells to the collective life of the organism. Between the two extremes of the living world, the yeast-fungus and man, there is the same difference as there is between a group of individual men who do not know how to organise their strength, and a strictly disciplined, well-ordered army suitably formed and well armed, and which, by the strict subordination of the many wills to the central authority, is always equal to the highest achievements.

It is true that these scientific researches into biology have left as yet the most important questions unsolved. It is not yet possible to regard all life-processes as simple modifications of the other forces of nature and to ascertain their mechanical equivalents ; we cannot yet convert absolute heat or light into life ; and although chemistry is daily doing more and more to bridge over the gaping chasm which once separated the organic and inorganic systems, it has not yet succeeded in finding out the precise matter which exclusively supports the life-process, on which alone the cells subsist. Thus, then, the beginning of life is still wrapped in obscurity.

After referring in this connection to the transmission of epidemics amongst plants, animals, and man, and to the microscopical labours of Leeuwenhoek, Ehrenberg, Gagniard-Latour, Schwann, and Kützing, Prof. Cohn goes on to say that the investigators of the present time, to whom Pasteur has given a powerful impulse, have been the first to establish beyond doubt that without *Bacteria* no putrefaction, and without yeast-fungi no fermentation takes place ; that this decomposition is accomplished only through the sustenance and living activity of those microscopic cells.

Many a mystery of life will doubtless be unfolded to us if our opticians during the next twenty-five years should manage to raise the power of the microscope in the same proportion as in the previous quarter of a century, in which it has been at least quadrupled. The best microscope of Schiek and Plössl in 1846 did not magnify more than 500 diameters ; the "immersion-lens xv." of Hartnack over 2,000 diameters. Still Dr. Cohn does not venture to hope that during the next twenty-five years all the questions of science which are at present being agitated will be solved. As one veil after another is lifted, we find ourselves behind a still thicker one, which conceals from our longing eyes the mysterious goddess of whom we are in search.

Dr. Cohn, in concluding his eloquent address, attempts to point out the characteristics which distinguish the present from the past generation. In the former epoch students confined their researches to single and carefully marked off divisions of nature, without any regard to the neighbouring and closely allied regions, which must necessarily lead to the one-sided view that these divisions belong to Nature herself. In the present generation, on the other hand, the several physical sciences have entered into the closest organic union. Physics and chemistry along with mathematical astronomy and geology, have been blended into a new science—the history of the development of worlds ; palæontology, systematic botany, and zoology have been joined into a united science of organisms ; the physiology of plants and of animals have become coalesced in universal biology ; the boundary between the organic and inorganic aspects of nature is being ever more and more obliterated, and out of the several natural sciences a single uniform, universal natural science is being constructed.

But the deeper natural science penetrates from outward phenomena to universal laws, the more she lays aside her former fear to test the latest fundamental questions of being and becoming (*Sein und Werden*), of space and time of matter and force, of life and spirit, by the scale of the inductive method, and the more confidently she lifts her views concerning the universe out of the cloudy atmosphere of hypothesis into the clear ether of theory grounded on fact, so much the more will the gap be narrowed which since Kant has separated science from philosophy. Schiller's advice to philosophers and men of science—

> "Feindschaft sei zwischen euch; noch ist das Bündniss zu frühe ;
> Nur wenn in Kampf ihr euch trennt, dann wird die Wahrheit enthüllt,"

has been followed for more than half a century, to the gain of the natural sciences, but often to the injury of philosophy, which would knock away the firm ground from under our feet. But since Herbart and Schopenhauer, and especially through Hartmann's labours, have the two chief drifts of the work of the human mind been approaching ; and if natural science has a mission to mould the future of our race, she must court the purifying influence of philosophical criticism : and this mission, in Dr. Cohn's estimation, the science of the future cannot reject. Its importance rests not merely in the much interesting and useful information which can be made available to trade and industry, for daily economy and universal civilisation ; she must build a sure foundation for our collective view of the universe, for our knowledge of ultimate and highest things. It must be no longer the case that even our most educated classes, in consequence of insufficient education, have neither interest nor intelligence for the pursuit and acquisition of scientific knowledge. Moreover, science will be no more able to shun battle with other systems of the universe which have been hallowed by the traditions of a thousand years, than were Socrates and Aristotle, Copernicus and Galileo. Victory will lie on the side of truth.

But if anxious souls should fear that with the advance of a scientific knowledge of the universe among the people, would come a breaking up of political and social order, let them be assured by the teaching of history. When we perceive the flash of an electric spark we certainly do not take it for a bolt darted by the revengeful Jupiter : and as the vault of Heaven is resolved into air and light, so also must the Olympus be shattered which was built thereon. But the ideas of the true, the beautiful, and the good remain unshaken; they have been all the more firmly established, for they have been deduced from the order of the universe and from the mind of man himself. And that the pursuit of natural science does not lead to materialism, and in no way injures the ideal mind, is vouched for by the case of Alexander von Humboldt himself, who, even in extreme old age, kept up his love for research and power of work as well as his lively susceptibility for and energetic share in all the noble pursuits of mankind.

Dr. Cohn concludes his lecture, so brimful of true eloquence founded on sober fact, with a high compliment to the many worthy qualities of the President of the Silesian Society, Dr. Goeppert. Such a man as he is said to be, the lecturer truly says, may hope, like Goethe, Humboldt, and other previous philosophers, to maintain to the utmost limit of existence, life, heart, and spirit full of the freshness of youth, and, moreover, in later generations be honoured as a true guardian of the highest good of grateful mankind.

VALENTIN'S CHEMISTRY

Introduction to Inorganic Chemistry. By W. G. Valentin, F.C.S. (London: J. and A. Churchill.)

WE must congratulate the author on the appearance of this volume. It is in reality a second and much improved edition of the first part of "Valentin's Introduction to Qualitative Analysis," and it is very encouraging that a second edition is so soon wanted. This book is one of a class which for the sake of English science we could wish were more numerous. It teaches chemistry entirely by practical work, and at the same time gives the student a clear knowledge of the general principles of the science. The very first words, indeed, afford a good idea of the system pursued throughout the work. Experiment 1.—"Fill a glass cylinder or a test-tube with water, and invert it over a basin containing water, &c." This experiment is the collection of hydrogen evolved from the action of sodium on water. This quotation may be taken as almost typical of the book. The methods of preparation and the properties of the various elements and simple compounds are studied by means of very carefully described and well-chosen experiments, and from his experiments the student is taught to draw deductions and generalisations. In this way the fundamental laws of chemistry are deduced from experimental facts, and a sound foundation of chemical knowledge is obtained. This method scarcely requires any recommendation; the fact that the author has adopted it after a long experience of practical teaching in one of our largest laboratories is one proof amongst many that the practical system of teaching is the only one which yields good and satisfactory results. This method of experimental teaching is now coming more and more into general use, and perhaps to a greater extent in chemistry than in any other science.

In the work before us there are 169 experiments carefully described, most of which are suitable for the student himself to perform; there are a few, however, the successful performance of which is almost beyond the capabilities of young beginners. The selection of experiments is left to individual teachers, and must depend to some extent also on the resources of the laboratory. It is a question whether some few of them are not more suitable for the lecture table, or to be performed under the immediate superintendence of the teacher. It would, perhaps, have been an improvement if the author had distinguished those experiments which he thinks are necessary for the student to perform. This would certainly assist a student working privately, and would to some extent be a sort of moral obligation on some teachers who might be inclined to run through the book superficially. Most of the experiments may be successfully performed if the directions in the book are adhered to, which are for the most part fully and clearly expressed. At the end of each chapter there is a short *résumé*, printed in italics, of the principal facts which have been demonstrated, and these form a very valuable part of the book. At the end of many chapters there is also placed a number of questions and exercises on the substance matter of the book, dealing, however, more particularly with those points which are found to be stumbling-blocks to students. It is recommended that the answers to these should be written out and examined by the teacher, which, though it would involve a considerable amount of labour, would render the laboratory teaching much more thorough and efficient. Many of the questions are by no means easy, and a student who can conscientiously answer them will have acquired a very fair knowledge of elementary inorganic chemistry.

The notation used is the same as that employed by Dr. Frankland in his "Lecture Notes." This, perhaps, may be a drawback to the use of the book by some teachers, although it appears that of late years this system has gained much ground. It consists essentially in the use of a series of compound radicals formed on the type of hydroxyl or peroxide of hydrogen, and in the employment of thicker type to represent certain elements which act as the grouping elements of each compound. Thus sulphuric acid is represented as consisting of the radical $\mathbf{SO}_2$ combined with two semi-molecules of hydroxyl, thus $\mathbf{SO}_2\,(HO)_2$, or, written according to the abbreviated formula, $\mathbf{SO}_2\,Ho_2$, when Ho represents a semi-molecule of hydroxyl; a sulphate, as, for instance, sodic sulphate, would be represented as $\mathbf{SO}_2\,(NaO)_2$, or $\mathbf{SO}_2\,Nao_2$, in which the monad radical Nao (sodoxyl) has replaced hydroxyl, basic sulphate would be $\mathbf{SO}_2\,(BaO_2)''$, or $\mathbf{SO}_2\,Bao''$, in which Bao'' is a compound dyad radical, consisting of one atom of barium and two of oxygen, and replaces the two semi-molecules of hydroxyl. The author uses the second of these formulæ throughout the work, although, perhaps it would appear slightly less complicated if the first of these two kinds of formulæ had been used. This system of formulating bodies with the use of this class of radicals has been employed for many years in the field of organic chemistry, so much so, that it is impossible to study this branch without being familiar with the system. We cannot see any reason why inorganic chemistry should not be treated in a similar manner, and we believe that this system will gradually and surely spread. Graphic illustration is also employed, and is very useful in explaining the constitutional symbolic formulæ employed in the book. There seems no doubt that the fear that students would materialise, as it might be called, these graphic representations was unfounded. The great argument advanced against the use of graphic illustration has been that students would imagine that it was intended to convey the positions of the atoms in space, and their linking or binding to each other; but in practice this has not been found to be the case. As soon, however, as the pupils have become thoroughly familiar and conversant with the use of symbolic constitutional formulæ, there is less necessity for the use of graphic formulæ, except, perhaps, in the case of complex isomeric organic bodies.

The theory of the atomicity of chemical elements is also used throughout the book, and the author states that he has found it to be remarkably conducive to the quick and thorough understanding of chemical changes. This theory is without doubt of great use in assisting the mind to generalise and grasp the numerous reactions of the elementary bodies, and by thus introducing this theory we are enabled to systematise to some extent the study of chemistry, and therefore to materially aid the memory.

The illustrations are numerous and well executed, and in almost all instances give a very good idea of the kind of apparatus, which should be employed in the various experiments. In conclusion we think that if a student were to work conscientiously through this book he will secure a fair knowledge of elementary inorganic chemistry, which will serve as a suitable groundwork for him on which to found an extensive knowledge of this subject. We therefore cordially recommend this work to the notice of all teachers of practical chemistry.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Periodicity of Rainfall

THE remark of Mr. G. J. Symons in NATURE, December 26, that it seems to him "more likely that the effect of cyclone is simply to alter the locality of deposition" of rain, suggests a doubt whether the relation between rain and wind is sufficiently considered. The amount of evaporation must always be the chief element in the question of rainfall, and the total evaporation of any period must be much affected by the amount of wind. Evaporation may go on rapidly in still air, but it is almost necessarily increased if the air is moving. Storms over the sea not only bring moving air over a wet surface, but they also very largely increase the area of that surface by creating waves and foam. The evaporation during a cyclone may be presumed to be enormous. Wind in fact is almost always drying, even when rain is falling.

May we not on this account see a theoretical probability in favour of Mr. Lockyer's belief that the cycle of sun-spots coincides with that of rainfall?

If the solar spots indicate inequalities of temperature, the sun's heat when they are numerous will be radiated in bundles of rays of unequal power. These we may suppose, being directly incident on different portions of the earth, will cause special barometric differences here. The result will be special winds, and therefore special evaporation; followed by unusual rainfall. The locality of this extra rainfall will of course depend on other causes, partly on the direction of the special winds, and if it should be thrown on polar regions or any other part of the earth where it escapes observation, there will be an apparent failure in the cycle. This also seems not inconsistent with experience as far as it goes ALBERT J. MOTT

Athenæum, Liverpool, Dec. 31, 1872

Eleven-Year Rainfall Period

THE Royal Exchange storm of Nov., 1838, happened twenty-two years before Prof. C. P. Smyth's Hyperborean one of Oct., 1860—twelve years ago. I have heard of a great one at Dantzic in 1816-17 (also twenty-two years before 1838). In a small book—"Chronological Tablets," published 1801, article on "Storms," great ones, in 1794, Oct. 6; 1784, Dec. 5; 1773, March; 1751, Dec.; 1740, Nov. 1; 1703, Nov. 26 (the Great Storm, *vide* "City Remembrancer," also *Nautical Magazine*, Jan., 1843, my extracts), this is not in the eleven-year series; 1658, Sept. (death day of Oliver Cromwell, fifty-five years before great 1703 storm), &c.

Now as the sun and moon are probably prime agents in these periodic hurricanes, we get $11 \times 365\frac{1}{4} = 4017{\cdot}5$ days, being 156 periods of 25d. 18h.; 147 periods of 27d. 7h. 7m.; and 136 periods of 29d. 12h. 43m., nearly.

$$\text{Hyp. log. } \pi = 1{\cdot}1447300 = \frac{7.11.223}{15} = \frac{17171}{15} \text{ very nearly.}$$

Offord Road, N., Dec. 16 S. M. DRACH

Pollen-eaters

FROM a note in NATURE, Dec. 19, it appears that it has hitherto been a mooted question among entomologists whether any species of Diptera are pollen-eaters. I have often watched certain slender-bodied flies, belonging to or allied to the family of Noverers (*Syrphidæ*), in the act of feeding on the pollen of various flowers, which they effected by a quick jerking and grinding movement of the mandibulæ. I once witnessed the exhibition of a much more surprising taste by one of these insects, which, together with a small yellow ant, I watched for a considerable time feasting on a gout of resinous matter that had exuded from a wound in the bark of a spruce fir-tree.

Mention of ants reminds me of Mr. Meldola's statement (NATURE, vol. vi. p. 279) that Dr. Bree has pronounced their aphis-milking instinct a myth. While an undergraduate at Cambridge, I have more than once been a pleased spectator of this mythical performance; but Dr. Bree's incredulity may be explained by the fact that all ants have not this instinct. At least, though for many years constantly on the look-out for it, only one instance of it has come under my notice on this side of the Channel. On one occasion when I introduced an ant among a number of aphides, her first act was to seize one of them in her jaws; but after carrying it for a short distance over the backs of its fellows, she released it, and made what haste she could out of the company of creatures whose polite attentions she seemed by no means to appreciate.

Kilderry, Co. Donegal W. E. HART

Fresh Water on the Coast of Tobago

WITH reference to my letter of the 11th ult. (NATURE, vol. vii. p. 124.) I forward the following further information with regard to the appearance of fresh water on the coast of Tobago, promised from the same correspondent.

"The appearance of foreign water on our southern coast in the months of August, September, and October, is by no means a rare thing. This water is always of a dark colour, emitting after a time a most offensive odour, and leaving on the beach a line of a frothy substance of a peculiar odour and yellowish green colour.

"The influx to which I called your attention surpassed anything of the kind ever seen here. I am not aware that anyone has tested this water, or preserved any portion of it. Mr. ——— had some brought to his bath for salt water, and thinking that his servant had played him false, he repaired to the bay, (Scarborough) and found the water there fresh instead of salt.

"There is much difference of opinion here as to the source of this water. Capt. ——— supports the views of those who hold that it comes from the Oronoko. To do this, that great river must force its flood 180 miles against the equatorial stream and trade wind, while the rivers to windward, *e.g.* the Demerara, Essequibo, &c., discharge their water into that stream, which impinges on our southern and eastern shores, leaving unmistakeable evidence of its power.

"May not the Amazon have something to do with this phenomenon? It is said to send its waters 'pure and unmixed' into the ocean 300 miles. I have had no information as to excessive rains on the continent." RAWSON W. RAWSON

Government House, Barbados, Dec. 2, 1872

International Book Conveyance

THE benefits conferred upon science by the Smithsonian Institution are known to all your readers. The object of this note is to ask if it is impossible to find in the old world wealth and energy enough to copy one small branch of Prof. Henry's excellent work. I refer to the Smithsonian system of book exchanges, and I wish to know how much longer it is to continue easier and infinitely cheaper to exchange publications with one's correspondents in the other hemisphere than it is between London and Paris. Let me give an actual case. I recently sent two identical parcels of books, one to Utrecht and one to Washington. The former cost 5*s.* 6*d.*, the latter cost nothing. In order that no one may run away with the idea that it would cost any very large sum to carry out this suggestion, I may remark that the Smithsonian system which is on a large scale, with agencies at Leipsic, Stockholm, Christiania, Copenhagen, Amsterdam, Paris, Milan, London, and Melbourne, besides its American ones, only costs 1,000*l.* per annum. We have only to copy on a diminished scale and to utilise existing agencies.

G. J. SYMONS

[See our note this week referring to an institution established at Haarlem.—ED.]

Dr. Cohn's Address

THERE is a passage in Dr. Cohn's address as reported in the Christmas number of NATURE (p. 137), which greatly needs correction:—

"Since, in the year 1842, an unknown physician in a Swabian country town, Dr. Mayer, of Heilbronn, pointed out that a hammer 424 kilogrammes in weight, which falls from the height of a metre on an anvil, raises the heat of the latter by one degree centigrade . . . "

Leaving historical accuracy out of the question, this is a gross misstatement of the physical fact. The correct statement is that the whole heat generated by the blow (which will be partly taken up by the hammer and partly by the anvil) will be as much as would heat *a kilogram of water* one degree centigrade.

Malone Road, Belfast, Dec. 28 J. D. EVERETT

[Dr. Cohn's words are:—"Seit im Jahre 1842, ein unbekannter Arzt in einer schwäbischen Landschaft, Dr. Mayer von Heilbronn, nachgewiesen hatte, dass ein 424 Kilogramm schwerer Hammer, welcher einen Meter tief auf einen Ambos fällt, den letzteren um einen Centigrad erwärmt," &c. ED.]

Salmonidæ of Great Britain

SOME months ago I inquired through the columns of the *Field* newspaper if any sportsman, fisherman, or naturalist would oblige me by replying to the following queries respecting the rarer *Salmonidæ* of Great Britain. Firstly, whether *Salmo ferox* (the great lake trout) had ever been taken in any lake in Wales, and, secondly, whether any of the Gwiniad tribe (*Coregoni*), such as the Gwiniad of Bala, the Vendace of Loch Maben, and the Powan of Ireland; or any of the Chars (*Salmo salvelinus*) have ever been taken in any lake which is not *a glacial lake*—that is to say, a lake which either lies in the tracks of an ancient glacier, or that is dammed up, or otherwise surrounded by moraine matter? The only reply with respect to the first query was from Sir Philip Egerton, to the purpose that he took a specimen of *Salmo ferox* in Bala Lake in 1871, thus establishing the fact that this fish still lingers in North Wales. To the second question I have received no reply. Is it possible that I may be more fortunate among the many naturalists and geologists who take NATURE?

Pendock, Tewkesbury W. S. SYMONDS

Geographical Distribution of Dipterocarpeæ

MR. BENTHAM, in his address to the Linnean Society, delivered May 4, 1872, remarks in a note, "Dr. Hooker has, for instance, remarked that no *Dipterocarpeæ* have been found east of Borneo;" but that in the present state of our knowledge it is premature to endeavour to establish well-marked limits between the flora of the western and eastern portions of the Indian Archipelago.

Padre Blanco (no great authority, however), describes several species of *Dipterocarpus* found in the Philippine Islands, and I myself sent to Mr. Robert Brown seeds of two species, one of which in shape and size resembled the figure given by Lindley in his "Vegetable Kingdom," in his illustration of the genus. The seeds of *Dipterocarpus* are so peculiar, that a mistake is not easily made in determining most of the species. From some of those found in these islands, valuable resins are collected. The wood of the trees, which are very large, is also of some economic value.*

Manila, Oct. 8 W. W. WOOD

Honest Cyclopædias

A FEW weeks ago Mr. A. R. Wallace asked in your columns if there existed such a thing as a cyclopædia which did not mislead or blind the inquirer by harassing and often useless cross references. As no one has yet answered Mr. Wallace's question, will you permit me to direct his attention to that admirable work, almost equivalent in its fullness to a cyclopædia and far superior to any cyclopædia I know in its recent and careful compilation, namely "Brande's Dictionary of Science," edited by the Rev. G. W. Cox. Rodwell's Dictionary is excellent, but is not so comprehensive as the last edition of Brande.

W. F. B.

"The Boring in Sussex"

ON the 9th inst. I was fortunate enough to find what I believe to be the *first fossil* from the Sub-Wealden boring at Netherfield, three or four shells of the genus *Cyclas*, in dark blue shale from a depth of 100 ft. There was also a small piece of what Dr. Bowerbank thinks is a *Paludina*.

As there are Wealden fossils, it is supposed that the borer has not yet got through the lower Wealden beds.

St. Leonard's, Dec. 17 J. E. H. PEYTON

Reflected Sunshine

THE recollection of a letter from Prof. Tyndall's pen, which appeared in NATURE some months ago, induces me to contribute an account of a curious sun effect recently seen from the summit of the Kudure Mukh, a hill nearly 6,200 ft. high.

The Ghauts here rise in bold scarps from the plains, large tracts of the latter being at this season under water, in preparation for the last rice crop.

Whilst resting one evening on the edge of the cliffs, I noticed as the sun declined that his reflection was approaching a series of sheets of water some six or eight miles off. Each of these pools cast upwards through the blue haze that overhung the plains a brilliant beam of light, the oblique rays from the water crossing those from the sun, and forming with them a chessboard pattern of light and shadow that was singularly beautiful.

As the sun dipped lower and his reflection fell full on the still expanse of water, the scene became almost magical. There shone a second sun at one's feet, its wealth of beams, undiminished in splendour, springing from the very bosom of the earth.

It required, indeed, but little stretch of imagination to fancy that a real sun was glaring up through some ghastly chasm in our globe. This phenomenon must be of frequent occurrence in many parts of the world, and wherever the distance between the observer and the reflecting surface is sufficient to greatly reduce the size of known objects, with which the eye naturally compares the apparent diameter of the reflected sun, the spectacle must always be a startling one.

Since my return from the district a friend who was camped at the Mukh prior to my visit there has told me that he also noticed the effect described above, and used to climb the hill every evening of his stay for the purpose of seeing it.

Mangalore, Nov. 21 E. W. PRINGLE

Electricity and Earthquakes

IT has been suggested that earthquakes may be caused by electrical discharges in the interior of the earth, and this may account for some remarkable effects of the great shocks which were so destructive to Manila in 1863.

It was observed that the effects of this earthquake were distributed in a peculiar manner over the comparatively small space occupied by the city and suburbs. On the banks of the river and canals, and through the northern quarter, great damage was done, while to the southward the mischief was comparatively slight. In parts of the town where large churches and other solidly-constructed edifices were ruined, other and slighter buildings placed near them escaped almost without injury. This was particularly noticed in the parish of Quiapo, where the church was destroyed, while two very tall and isolated houses at a short distance escaped. One of these houses has a side-wall nearly 60 ft. high, and another one supported by other houses. The same partial effect was observed in other places, the terrestrial disturbance having been, as it were, distributed in veins or currents, in the line of which everything went down; but outside of these limits the damage done was comparatively slight. The exaggerated accounts published of the loss of life and injury to the city have probably never been exceeded.

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* The wood of one very large species, according to Padre Blanco, was formerly used in building the famous Acalpulco and Manila galleons, from the circumstance that, when pierced by cannon shot, it does not splinter in the way most other timber is found to do.

We hear from the province of Albay (the southern extremity of the island of Luzow) that the grand volcano, the Mayon, was again in eruption, though at the last advices no damage had been done. This is perhaps the most beautifully symmetrical volcano in the world. From almost every point of view the outline is equally elegant. A few years ago I was fortunate in witnessing a fine eruption of the Mayon, which lasted for many days. By means of a powerful telescope I was able to watch its progress from a station at the base of the mountain. The ejected matter appeared to be red-hot stones only,* nothing like lava streams being visible. Indeed most of the volcanos of the Philippines throw out only scoria, ashes, and, it is said, in some cases hot water; but all information on these subjects is so liable here to gross exaggeration, that little dependence can be placed on anything but personal observation.

Another volcano, about 20 or 25 miles from the Mayon, called the Bulusan, which has been dormant for many years, began to throw out columns of smoke soon after the eruption of the Mayon, which I witnessed.

I regret I have not been able to ascertain whether these volcanic disturbances have had any effect upon the thermal spring of Tivi at the base of the Mayon in causing an intermission in the flow, &c. The waters of these springs, which are very limpid, deposit large quantities of silicious scuter, which encloses anything thrown into them. I have a piece of ordinary mat, which, in vulgar phrase, is completely petrified. The temperature is nearly boiling; but it is dangerous to approach the openings too nearly, and thermometrical experiments are difficult. Some of the concretions from certain parts of these springs are very massive, and when broken appear to be a nearly transparent silex.

Manila, Oct. 7 W. W. WOOD

P.S.—The post brings further accounts of the new eruption of the Mayon, which has assumed a formidable character, and is said to be the most violent which has occurred for many years. Some lives have been lost among the natives, who have their Manila hemp plantation on the flanks of the volcano, and great apprehension prevailed in all the villages around the base of the mountain. The new volcano on the island of Camiguin remains in a semi-active state—smoking, but without any regular eruption. Those who have visited it lately report that it is steadily increasing in volume, the irregular mass becoming larger daily, and working towards the sea. The inhabitants have generally returned to the island, but the villages in the immediate neighbourhood of the volcano are still deserted. Camiguin is important from its plantations of Manila hemp (*Musa textile*), and a good deal of capital is invested in them.

Oct. 10

Atmospheric Refraction

IF Mr. Wallace is still in search of facts on unusual atmospheric refraction, I would refer him in the first place to "Scoresby's Arctic Regions," and Scoresby's "Greenland," in both of which works very full and accurate information is given as to facts observed by the author; in the second place to the Phil. Trans. for 1798, 1799, and 1800, containing papers by Latham, Vince, and Wollaston; thirdly, to "Annales de Chimie," first series, vols. 29 and 39; the former containing a paper by Monge at p. 207, and the latter a paper by Gorsse at p. 211.

More recent observations are described in NATURE for July 28 and August 25, 1870, and August 25, 1872.

If any of your readers can inform me of any important contributions to the literature of Mirage besides these above mentioned I shall be greatly obliged.

J. D. EVERETT

*BIELA'S COMET**

"BIELA'S Comet is my subject this time. A startling telegram from Prof. Klinkerfues on the night of Nov. 30 ran thus:—'Biela touched Earth on 27th: search near Theta Centauri.'

"I was on the look-out from comet-rise (16^h) to sunrise the next two mornings, but clouds and rain disappointed me. On the third attempt, however, I had better luck. Just about $17\frac{1}{4}^h$ mean time, a brief blue space enabled me to find *Biela*, and though I could only get four comparisons with an anonymous star, it had moved forward $2^s{\cdot}5$ in four minutes, and that *settled* its being the right object. I recorded it as—'Circular; bright, with a decided nucleus, but no tail, and about 45″ in diameter.' This was in strong twilight. Next morning, Dec. 3, I got a much better observation of it; seven comparisons with another anonymous star; two with one of our current Madras Catalogue Stars, and two with 7734 Taylor. This time my notes were—'Circular; diameter 75″; bright nucleus; a faint but distinct tail, 8′ in length and spreading, a position angle from nucleus about 280°.' I had no time to spare to look for the other comet, and the next morning the clouds and rain had returned.

"If I get another view before posting this I may be able to add a hasty postscript. The positions, the first rough, the second pretty fair from the two known stars, are—

	Madras M.T			R.A.			(Apparent) P.D.		
	h	m	s	h	m	s	°	′	″
Dec. 2	17	33	21	14	7	27	124	46	
3	17	25	17	14	22	2·9	125	4	28

HINTS ON COLLECTING ARACHNIDA

IT having been suggested to me by Mr. Sclater that a few hints on the collecting of *Arachnida* might be of use for natural history collectors and travellers in foreign parts, I have had great pleasure in drawing up the following notes on the subject, and shall be glad to receive collections of these animals from any part of the world.

1.—What are *Arachnida?*

These are Spiders, Scorpions, Harvestmen, and Mites with several other allied groups (which have no English names), such as the *Thelyphonidæ*, semi-scorpion-like creatures with a slender palpiform tail, and of considerable size; the *Phrynidea*, short-bodied creatures of a somewhat spiderish appearance, but often of large size, with a horny skin, and fore-legs of immense length and great slenderness; and the *Solpagidæ*, creatures which, if they can be said to resemble any others, are perhaps more like abnormal-looking spiders with a heavy head and great double jaws than anything else.

2.—What places do *Arachnida* live in?

Little need be said on this, for there is no place so barren, or so fertile, or so wet, or so dry, or so stony, but that some, and generally most, of the *Arachnida* may be found in it. Collectors abroad are often prevented from collecting birds or insects by weather, but *Arachnida* may be got in any weather, even if the collector be confined to the house. Numerous species may be found in corners and crevices; beneath old bark, or detached rocks and stones, myriads of spiders haunt. They are also to be found among moss and *debris* in damp places, in holes, in banks and river-sides; among the lower stems of grass and rank herbage, and the borders of swamps and ponds; on tree trunks, among lichens, on bushes, in blooms of flowers—in fact, to repeat it, everywhere; often moving in the hottest sunshine, and often concealed during the day, coming abroad at dusk and in the night.

3.—How to collect *Arachnida.*

The mere modes of capturing them need not be much detailed; there is an advantage in respect to *Arachnida* over all the *Insecta* in their being unable to fly. The greater number may be seized with the fingers with a little practice, and immediately plunged into a bottle of spirits of wine, or any other strong spirit; but many large ones may be boxed with large pill-boxes (of course, only one in each box), and at the end of the day may be suffocated with brimstone or chloroform, and then put into the spirit. Where a collector is collecting insects, he may catch many swift-running or strongly-jumping spiders by placing his open net in front and driving them into it with the other hand. A large umbrella is a first-rate implement for beating boughs or long herbage into.

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* These appeared as if slowly pushed up from the interior of the crater, and, rolling out over its edges, went thundering down the cone, throwing out showers of fire as they struck the rocks or each other. This eruption was well seen by me from two opposite stations, and was said to have been equally fine when viewed from all sides of the mountain.

* Extract of a letter from Mr. N. R. Pogson, Madras Observatory, to the Astronomer Royal, dated Dec. 5, 1872.

4.—What to do with *Arachnida* after having caught and bottled them.

All that need be done is to put as many into a bottle as can be fairly got into it. There is no need to put large specimens into one bottle and small into another; for it is found practically that a judicious mixture of large and small is of no disadvantage, but rather the contrary.

One special point to be always observed is to fill up the bottle, where the specimens do not quite do so, with small bits of soft paper crushed up and gently inserted, until the contents fail to move about with the motion and shaking of the bottle.

The best bottles are ½ oz. phials, 1 oz., 2 oz., and 4 oz. wide-mouthed ditto, all of which are kept in stock by chemists or bottle-makers in England. The smallest of these will hold a large number of small specimens, and the largest are large enough for all except a very few of the gigantic *Mygalidæ* and scorpions; for the latter it must be a barren region which will not furnish an empty pickle-bottle capable of holding some scores of the largest species. Tight corking is, of course, necessary, and in hot regions tying down of the corks.

Of course any notes on the sexes of species or their habits, &c. as well as on their colours, as these sometimes fade in spirits, are valuable; and where notes can be made, there should be a supply of test tubes of various sizes into which the example noted should be placed with a written card or letter, with a parchment number corresponding with the numbered note. The tube should then be filled with spirit and stopped firmly with a piece of cotton-wool, and placed *wool downwards*, in one of the wide-mouthed phials. A number of tubes may thus be packed into a phial, but spirits should also be always put into the phial as well as into the tube.

Where there is a fear of handling spiders of large size, or scorpions, a simple pair of forceps may be made of a piece of bent hoop-iron, rivetted at the bend through a piece of inserted tough wood, this gives sufficient spring to keep the digital joints always extended a little way. With these forceps *Arachnida* of a large size may be safely caught, or extracted from holes and crevices.

Mr. Bates' plan for killing the Mygales on the Amazons, was to get them into a tin pot or box, put the cover on, and place it for a few minutes upon the glowing embers of a charcoal fire. These means of killing may be used where neither brimstone nor chloroform are available.

From the above hints it will be seen that, compared to the trouble of collecting birds, mammals, or insects which require careful setting and drying, the trouble of collecting and preserving *Arachnida* is *nil*, and in all tropical regions an intelligent native would collect hundreds of specimens in a day if he were only furnished with two or three large bottles full of strong spirit.

Thus all that is necessary for the complete equipment of a collector of *Arachnida* is a large umbrella, a pair of forceps (such as are above described) about twelve inches long, two or three dozen of the bottles above-mentioned, a hundred or so of test-tubes of different sizes, a little cotton-wool, soft paper, and some strong spirit, which may be got on the spot nearly everywhere.

O. P. CAMBRIDGE

INTRODUCTORY LECTURE OF THE MURCHISON CHAIR OF GEOLOGY AT EDINBURGH, SESSION 1872-3 *

BEFORE entering on the special subjects to be treated of in the following course of lectures, it is most desirable that we should definitely shape to ourselves the objects we have in view. By doing so we can the better take stock from time to time of our gains, and judge at the end how far we have succeeded in achieving any solid advantages.

Now, if I put the question frankly to you, What do you propose to accomplish by voluntarily placing yourselves under such a course of instruction as that which begins here to-day? you will, perhaps, reply that your desire is to know something more of a science which offers to your minds so many points of interest.

The task you have undertaken promises to be a pleasant one, and possibly all the more so since there may be a very general impression among my audience that your duties here will be rather an exercise of the memory than of the reasoning powers, and hence a not unwelcome relief from severer studies.

I should be sorry to dispel so pleasing a belief; on the contrary, it would give me some assurance that if our conjoint efforts fail the fault will lie with me, and not with you. Nevertheless, I have a deep conviction that, in seeking here merely an addition to your knowledge, you would neither do justice to the subject we are to study nor to yourselves.

I know only too well that the imparting of knowledge is popularly supposed to be the only aim and purpose of natural science teaching, and that this notion pervades our system of education. I believe it to be but a partial view of the truth; and even at the risk of being thought dull I would lay before you another view, that you may see what additional objects you may, in my opinion, accomplish here, besides storing your minds with facts.

No one who thoughtfully considers the state of public feeling in this country at the present time can doubt that we are on the eve of educational changes more momentous than any which have come to pass for centuries. It is not merely that education has become a political cry; that it forms a staple element in the declamations which fill the air from the halls of St. Stephen's to the village green; and that all this oratory finds further exposition and enforcement in the public prints. It is not merely that we believe it will be hard, a generation hence, to find a man or woman throughout the land who cannot at least read and write. These results, profoundly important as they are, do not fill up the whole measure of change which is impending, nor are they those which most nearly concern you and me at present.

It is impossible that such radical reforms should be worked in the primary education of the country without an influence, and perhaps an extremely potent one, upon the higher forms of culture. On every side, indeed, we can already descry indications of the coming changes—changes, however, which are not wholly, nor even, perhaps, chiefly, due to the disturbances of our primary educational system, but which would assuredly have been brought about, even had no sweeping Parliamentary legislation taken place.

Nowhere can these indications be more significantly seen than among those conservative educational centres, where it might have been supposed that the call for reform would have been longest in making itself heard and obeyed. Even there the old and time-honoured traditions are losing their hold. The young blood of a newer time has begun to quicken some of the most dormant of our institutions.

Uncompromising opposition is apt so to embitter a struggle, that what is at first only a desire for reform partakes in the end somewhat of the blind fury of a revolution.

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* Given on Nov. 11 by Prof. Geikie, F.R.S.

It is, however, a happy omen for the future of higher education among us that some of the most strenuous champions of change are to be found among those whose vested interests and traditions might have been deemed likely to ensure their conservatism. These men are not in much danger of going too far, and yet their earnestness is a guarantee that they certainly have no intention of standing still. The foundations on which the culture of centuries has been built are not to be ruthlessly pulled up; but the time has assuredly come when they need to be broadened and widened.

Let no one imagine that such words as these imply any want of reverence for the time-honoured means of mental discipline. Literature and philosophy have ever taken, and must ever take, the foremost place in intellectual culture. They bring mind in contact with mind, and with all that is highest and noblest in the history of humanity. There was a time, indeed, when they comprised the whole sum of human thought. That time has long passed, and yet, in our traditional system of education, we still perpetuate its memory. But man has since then discovered that, although he be indeed a marvellous microcosm, there lies outside of him a great world full of infinite diversity wherein he can, nevertheless, discover such a unity of plan as links even his own being with every part of nature.

It is not now enough that man shall know what his forefathers have thought, or written or done, nor that he shall content himself with studying the nature and workings of his own mind, or busy himself with abstract principles of magnitude and number. Now why is this so? Because during the last two hundred years his relations to the external world have been so thoroughly altered. He is no longer a mere higher kind of animal, ignorant almost as other animals of the phenomena in progress around him, and well-high as helpless as they in the inevitable struggle with the elements. For thousands of years he had aspired to rule over but one, and that the least, of the domains of which he was made lord at the beginning:—he was content with undisputed dominion over the beast of the field, and the fish of the sea, and the fowl of the air. He has now claimed the right which was his by the same charter to have dominion over the earth and to subdue it. So that now his mastery is hardly less decisive over air, and land, and sea. He can bend the energy of nature to do his humblest offices.

What is it, then, which has made this difference between man's power in this present time and that which he possessed only a few generations ago? Can you trace it to the teaching of the schools? Is it the fruit of that traditional system handed down to us from older centuries? Assuredly not, it has sprung from a sphere of education outside of the schools. It is to be traced, without doubt or cavil, to the strides which modern physical science has taken. Man has gone to school elsewhere than in the class-rooms. He has proved himself too, to be an apt pupil, for in the comparatively short space of time in which he has given himself to these pursuits, he has gained such a mass of knowledge as has enabled him to work greater changes on the face of the globe and on his own relations to it than had been effected during all the previous centuries put together.

By this wide-spread dominion over nature we stand separated by a kind of gulf from our forefathers. And yet strange as it may seem, we have made no corresponding change in the range of subjects which are still prescribed for the higher education of the country. We send our young men and young women to be trained very much in the same modes which were in use a couple of centuries ago or more. We live in the days of railways and telegraphs, and we educate our youth as if they lived before the introduction of mail-coaches.

It is true that both in the higher schools and colleges, certain supplementary subjects, of which natural science is one, may be taken at the option of the learner. But these subjects are not made essential parts of our higher education, nor does any provision exist for making them more than mere sources of information. They are not in any way made use of as implements of intellectual training. And even the use to which they are put is so slight that a man may attain the highest academic honours and yet remain as ignorant as a school-boy of the commonest facts and phenomena around him, and of the causes which make his own age to differ so prodigiously from the ages which have gone before it.

I remember being much impressed with this fact, when as a boy, I met among the hills of Skye, a man who had not long taken his Master's degree at Cambridge and who had retired to that remote region for the purposes of further study. We happened to get into conversation regarding the origin of the mild climate of the north-west of Scotland. On being questioned, I referred to the influence of the Gulf-stream, My friend, however, had never heard of a Gulf-stream, refused to believe it to be more than one of what he called my "geological speculations," and would hardly even credit the schoolmaster, who, when appealed to, gravely assured him that he had heard of the Gulf-stream before I was born.

This may be an extreme case, but it is an actual one. It serves to show that though a man can hardly fail to pick up some acquaintance with science in the course of ordinary conversation or in reading the current literature of the day, no provision exists for making instruction in the meaning of the ordinary every-day facts of nature a necessary part of education, and that a man may gain his academic honours even without such instruction.

I am well aware that in one way or other a smattering of at least one science, sometimes a confused jumble of several, is very commonly carried away from school. The science-classes there, though they may be wholly optional, are often also popular with the scholars. Interesting experiments, pretty specimens and amusing diagrams are exhibited, and some amount of information is communicated, even if no special interest should be awakened in the subject, and no clear mental gain should be the result. But this is far from the sort of position which, as it seems to me, science ought to hold in higher education.

If culture is to be really liberal, that is, free and generous, surely it ought above all things to reflect fully and fairly the spirit and character of the time. If it shuts out this influence and continues to maintain the standard fixed for a wholly different time, does it not cease to be truly liberal? Full of reverence for the past, and striving after the fullest use of the heritage of wisdom which the past has bequeathed, a liberal culture, to be worthy of the name, must recognise that no standard however serviceable for the time in which it was erected, can be permanent; and that the limits which it sets for its own age cannot bind the ages to come. For the laws of continuity and evolution embrace the workings of the human mind as well as the operations of outer nature. And in the end it will be as impossible to keep the flow of youthful thought confined in one narrow and old-fashioned channel as it would be to restrain the river which is every moment rising to overflow its banks.

No great foresight is needed, therefore, to perceive that before many years are past the stereotyped curriculum for what is called a liberal education, whether in higher schools or in the universities, must be modified. It is not enough that a young man or a young woman should be permitted a choice as to the acquiring of some knowledge of science beyond that needed for the old standard. This knowledge, but still more the intellectual training by which it was originally obtained, should be an essential part of any system of education truly deserving now-a-days the name of liberal. And the want of this training should be regarded as quite as serious a defect in education as an ignorance of Latin or mathematics.

(*To be continued.*)

ON THE SPECTROSCOPE AND ITS APPLICATIONS

I.

WE now approach Newton's great discovery, which is this:—"*The light of the sun consists of rays differently refrangible*;" that is to say, if we take a beam of sunlight, and make it pass through a prism, we shall get colours of different refrangibility. We see then that if, instead of two coloured beams, we pass one of perfectly white light through the prism, the action of the prism is at once to turn that beam into a beautifully coloured band, which will remind you of a rainbow. It was this which Newton did in a dark room, which led him to his important discovery. White light is compounded of light of different degrees of refrangibility. But how is it possible to show the truth of Newton's assertion that white light is compounded of these different colours? We can do so by simply placing in the path of the coloured beam which you see passing through the room, another prism placed in a contrary direction, as shown in Fig. 10: you see in a moment that we get back white light; for the second prism exactly neutralises the effect caused by the first, and the ray proceeds as if nothing had happened.

Possibly you may ask, is it true that white light is built up of all colours? That question can be answered to a certain extent by an experiment of a different order. If a disc, divided into sections and coloured with the principal colours of the spectrum as shown in Fig. 11 be taken, and if it be true that the idea of white light is simply an idea built up by the eye, because we have all these multitudes of light waves perpetually pouring into it with a velocity that is very much greater than anything which can be translated into words, surely we should get something like this effect also if we were able, by rapidly rotating this screen, to obtain a more or less perfect substitute for white light. The coloured disc being made to rotate rapidly, you see we obtain something like an approximation to white light, though the white colour does not come out so clearly as it might do. Now I am very anxious that you should see that this is really an effect due to the flowing in of light from different parts of that wheel into the eye, and so forming this compound impression, which is conveyed to the brain; and so if instead of illuminating the disc continuously by the electric lamp, or by sunlight, it is illuminated intermittently, by an electric spark, you would see that although the disc is rotating rapidly all the time, each separate colour is now discernible, and the disc appears to stand still. The reason of this difference is, that in one case the rotation of the wheel builds up a compound image in the eye, and in the other case it cannot do so, because the flash of the light is much more rapid and instantaneous than the rotation of the wheel.

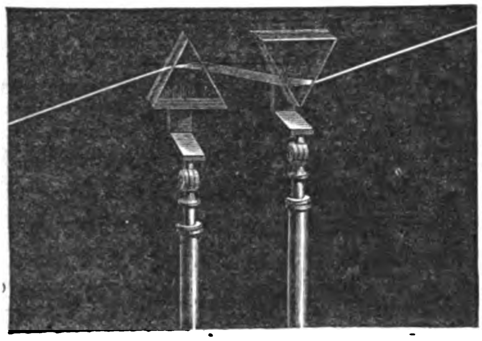

FIG. 10.—Recomposition of white light by means of a second prism.

There is one more experiment which can be easily made, to show that all the beautiful colour which we get in nature is really reflected after all, and that if our sunlight, instead of being polychromatic—that is to say, compounded of all these beautiful colours—were monochromatic, or of one colour only, the whole expanse of creation would put on a very different appearance from what it does. If, instead of illuminating a diagram, the letters of which are of different bright colours, by the white light of the electric lamp, we illuminate it by a light that only contains one colour—by the yellow light of sodium, for instance, and then look at the diagram, you will see that some of the letters upon it are almost invisible, whilst others are very clear, the yellow light only allowing a difference to be seen of more or less depth of shade, there being no difference in colour. But when we allow the polychromatic light from the lamp, or as we get it from the sun, to shine upon the diagram, you at once see that all these letters are of different colours, and burst out, as it were, into beauty. This experiment feebly indicates the advantage we possess in living in a universe lit by white or polychromatic light, instead of light which is merely blue, or yellow, or any other single colour.

Hitherto we have spoken only of refraction. I now introduce the word *dispersion*, which represents simply a measure of different refractions, or the difference between the bending of the red and the violet rays of light. In an ordinary spectrum the difference between the red and the violet is the difference of the refraction of those two colours by the prism, and the angle which the red, or yellow, or other colour forms with the original path of the compound-beam is called the *angle of deviation*.

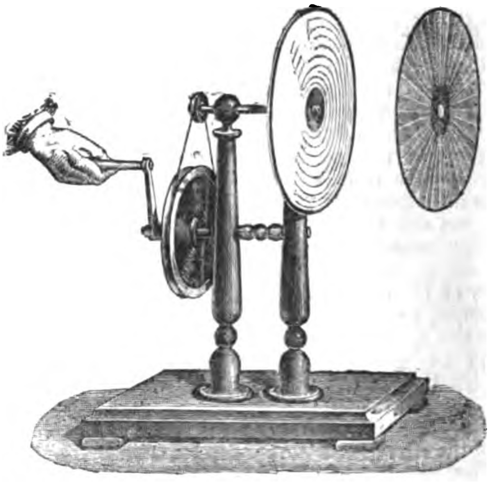

FIG. 11.—Recomposition of white light by means of a rapidly revolving disc coloured in sections.

There is one other consideration which we owe to Newton. In his very first experiments, that great philosopher discovered that the quality of the spectrum depended very much on the following consideration:—If I wish to get the best possible effect out of a prism and the purest possible spectrum, I have so to arrange it that the particular ray which I wish to observe, whether the yellow, the blue, the green, or any other, leaves that prism at exactly the same angle as the incident compound ray falls on it. This angle is termed the *angle of minimum deviation*.

The two things, therefore, of greatest importance in this subject which we owe to Newton are, first, the explanation of the dispersive power of the prism; and next, the pointing out the extreme importance of arranging the prism, so that if we want to observe any particular part of the spectrum, the rays constituting that part of the spectrum should leave the prism at the same angle as the white light falls on it.

It is very curious, however, that Newton, although he made many experiments on prisms, really omitted one of the most important points, which you will see carefully arranged for in every one of the spectroscopes used at the present day. And here again we get an idea of the enormous patience which is necessary in these matters, for we had to wait a century and a quarter before the next essential point was hit upon in the construction of a spectroscope. Newton made a round hole in a shutter for his experiments, but we now know that he ought not to have done that; he ought to have made a slit. But this did not come out until 1802, when Dr. Wollaston, by merely using a slit instead of a round hole, made a tremendous step in advance. You will see the importance of this in a moment. If we take a cylindrical beam of sunlight and put a prism in the path of the beam, we observe that the spectrum is not a pure one; but if we change the round hole for a slit, we obtain a spectrum of the greatest purity; the red, blue, green, and violet, instead of overlapping and destroying the beauty of the spectrum, show distinctly as simple colours, each one speaking for itself on the screen. By using this narrow slit instead of the round hole which Newton made in the shutter, we got the first idea of the tremendous importance of spectrum analysis; for no sooner had Dr. Wollaston examined the sunlight with the new arrangement, as Newton had done a century and a quarter before with the old one, than he found out that it was not at all as Newton had represented it. Newton told us in fact that the sunlight was continuous, that is to say, that the spectrum was one in which there was no break in the light which flowed out to every part of the spectrum, from the extreme red to the violet. When Dr. Wollaston tried the slit he found, however, that the spectrum, instead of being that rainbow band of light which you have seen, was really broken by a succession of fine—beautifully fine—black lines.

These lines were observed by Dr. Wollaston, but it was not till 1814 that we find them mapped out with the greatest care, to the number of 576, by a German optician named Fraunhofer; hence they are termed "Fraunhofer lines," the principal ones being lettered A, B, C, &c.

If we say, then, that spectroscopic inquiry dawned with Newton, certainly the sun began to rise with Fraunhofer, for he, no longer content with getting a sunbeam through this slit, and finding out and measuring with most admirable accuracy these 576 lines in that band of colour, turned his telescope to the moon and the planets, and the different stars; and he discovered that, in the case of the stars, the positions of the lines varied considerably from those they occupied in the spectrum of the sun; and this is one of the most important discoveries which has been made during the present century in these matters. Indeed, it is the foundation of very much of the later more detailed work.

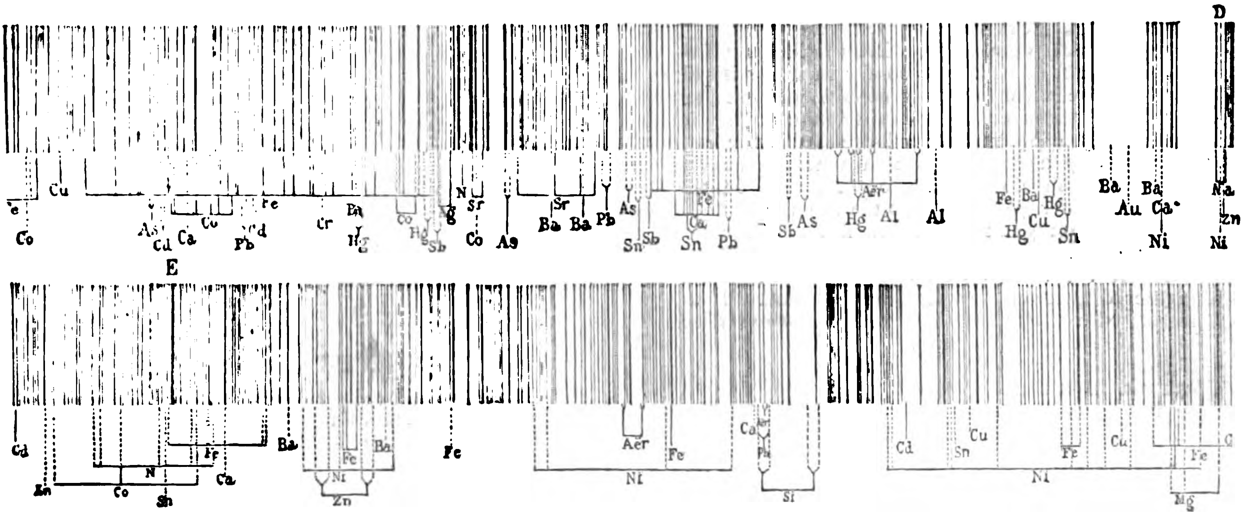

FIG. 12.—Upper diagram, Spectrum near D: Lower diagram, Spectrum near E.

The solar spectrum then, as we have said, far from being continuous, is crossed by an almost innumerable number of dark lines, some being fine and others thicker and blacker. Fig. 12 shows a small portion of the spectrum in the yellow and green. Other observers, such as Kirchhoff, Thalén, and Angström, have worked at these dark lines, and have drawn most beautiful and elaborate maps, showing at least 2,000 lines of various thicknesses.

We have now to pass on from 1812 to the year 1830, when Mr. Simms, an optician of world-wide reputation, made another very important improvement in the spectroscope. Instead of merely using a prism and observing the slit with the naked eye, he placed a lens in front of the prism, so arranged that the slit was in the focus of the lens. The light which is allowed to pass through the slit is thus turned into a cylindrical beam, and thus travels through the prism; then, instead of having merely the eye to observe the spectrum, there is another lens which grasps the circular beam and compels it to throw an image of the slit, which may be magnified at pleasure. The very great importance of this construction is at once obvious, if you think for one moment of the figure showing the lines in the solar spectrum. We now know, and it is not too early to place this before you, that these black lines indicate regions in the spectrum where there is no light. If the light is perfectly continuous, so that every ray of light is enabled to register itself at the end of the telescope, by painting an image of the slit, you will get a continuous spectrum; but supposing, for instance, that the whole of the yellow light were absent, it is clear that the spectroscope, if it does its duty well, will give you blackness where the yellow light is absent. We do not find that the whole of any particular colour is absent, but here and there, scattered over all the colours, there are these places where the rays of light do not come to tell their story. This is the explanation of the Fraunhofer lines in the solar spectrum. In the light which we get from the sun, certain of the rays which we may suppose ought to come to us, do not come, and we get no news from them. We do get news of some of the other rays, which show us the various shades of blue, of green, and so on; but here and there a ray, which possibly might have come if it were not better employed, does not come, and therefore the image of the slit cannot be painted.

I am glad to say that we know a little more about these lines than we did some years ago. You may imagine the enormous mystery—the wonderful reverence almost—with which this question of the Fraunhofer lines was approached, until they were thoroughly understood; and recollect that we owe the discovery of them—by which we are enabled now to determine the pressures acting in the atmospheres of the most distant stars—simply to the fact that Dr. Wollaston, instead of drilling a round hole, used a slit; and to the other additional fact, that Mr. Simms, instead of using that slit with a mere prism, used a lens and made the beam parallel, and then allowed that parallel beam, after it had passed through the prism, to pass into another telescope, and form an image of the slit. You see how closely connected are the grandest discoveries with the skill and suggestiveness of those who supply different instruments for our use.

Now I must ask you to come back again to the prism. I have already told you that dispersion is the measure of the difference of the refrangibilities. If we take a prism which appears like an ordinary one, but really is composed of several layers of different kinds of glass, and pass an ordinary beam of light through it, it will be differently acted upon by the various layers, and we shall get a difference in the spectra. We have here, in fact, three distinct spectra, showing that there is something in the different layers of which this prism is composed which turns the light out of its path, and which disperses it more in some cases than it does in others. The cause of this is the density of the glass composing each layer: some kinds of glass are nearly twice as heavy as others, and fortunately we are not limited to glass, for if we were we should not be able to go so far in these inquiries as we do. The prism in reality consists of three separate pieces of glass of different density, and it may be seen that the three spectra obtained are differently refracted. It is a very natural conclusion that the heavier and denser glass should have a stronger action on the light than the lighter glass has. So that, in these inquiries, if we want to get great dispersion, not only must we use heavy glass, but we leave glass behind altogether, as amongst the liquids we find some which give even a greater dispersion than the densest glass. If a beam is passed through a hollow prism of glass filled with bisulphide of carbon, the spectrum obtained is much longer than that produced by the densest flint glass we can get. But there is another consideration to be borne in mind. The dispersive power and refractive power not only depend upon the density of the glass, but on the angles of the prism. If a beam of light is sent through two prisms of unequal angles the effect is extremely distinct. Thus, if we take one prism with an angle of 20°, and another with an angle of 60°, the larger angle gives us a much greater deviation and dispersion; therefore, we not only have density to help us, but we have also the angle of the prism.

And now let us go on to a third important point in the matter. We are not limited to one prism if we wish to get a great amount of dispersion; if you will think the matter over, you will see that there is no good reason why we should not employ two, and then you will find that the dispersion will be considerable. So you see, first, we have a single prism of a dense substance; by increasing the angle we get increased dispersion, and then we get it still further increased by adding another prism, and so we might go on, adding prism after prism, until we get to any number of prisms arranged in the best possible manner for the light to be successively dispersed by each of them. First of all, you have the dispersive power of glass, then you have the angle of the prism, and then you have a number of prisms, all of them capable of being so arranged that we can make them all useful in these inquiries, until at last we get a dispersion of such an enormous amount that the spectrum of the sun, as mapped by Kirchhoff and Bünsen, is several yards in length, although it is nothing but a succession of images of one of the finest slits which our best opticians are able to make.

You see, therefore, that our spectroscope depends first of all on Newton's work with the prism in 1675, and on the fact which Newton found out incidentally, that it is important that the prism should be used at the angle of minimum deviation. We then get the slit added by Wollaston in 1812; then the collimating lens, added by Simms, in 1830. In this way we have arrived at the spectroscope improved and modified as an instrument, until at last we get spectroscopes so arranged that the glass is of the finest possible material, the angle being the largest possible, the glass the densest possible, and the number of prisms as great as possible.

There are some other considerations connected with the manufacture of spectroscopes which it is hardly necessary I should bring before you, as they are rather more in the nature of detail than of general principles; but I must point out that where liquids are employed, it is absolutely essential that the temperature should be as equable as we can get it. A current of warm air in a room is quite sufficient to render any spectrum obtained by these liquid prisms perfectly useless; hence, although their great dispersive power is of great value in some cases, where we want dispersion more than anything else, still, as a rule, we are limited for nearly all our researches to these dense glass prisms of great angle, to which I have already alluded. But there is another consideration of great importance which comes in here. If the angle of a prism be large, a ray of light travelling from one prism to another, enters the second at an extremely small angle, under which circumstances a large amount of light is reflected, but still it is not better to use a greater number of prisms of a smaller angle than a smaller number of a larger one. Again in spectroscopes of many prisms it is essential that there should be some arrangement by which each part of the spectrum should be observed with each prism at the angle of minimum deviation for that ray. This may be done in many ways, and the beam may be made to pass back again through the prisms, thus doubling the amount of dispersion. On these points I shall have more to say presently.

Another important consideration, besides the purity of the material, is the perfect figure of the slit. You might imagine that the slit of a spectroscope was perfectly easy to make; but, judging by the results of the manufacture, it is extremely difficult, for a perfect slit is still very rare, the best being made by Steinheil of Munich. Mr. Browning has suggested making the slit of a compound of gold, which will not rust, or be acted upon much by temperature, and which also will take a good figure without any very great difficulty.

NORMAN LOCKYER.

(*To be continued.*)

NOTES

THE Académie Royale de Belgique has elected Dr. Hooker "Membre associé." This has been done as their contribution to the Kew controversies. Prof. Monen, writing from Liege, is glad that Dr. Hooker has received "le plus haute distinction scientifique que notre pays peut conferer . . . dans une moment on vous (Dr. H.) soutenez une lutte vive et penible pour l'honneur de la botanique."

IN their desire to uphold the standard of medical teaching, the authorities of Charing Cross Hospital have committed an act which presents the appearance of an injustice. Not only have they not elected anyone to the vacant post of Demonstrator of Anatomy at their school, but they have sent the following announcement to each of the candidates:—"Resolved: That in the opinion of this Committee, the gentlemen who have offered themselves as candidates for the Demonstratorship of Anatomy have not had sufficient practical experience in teaching anatomy to justify the Committee in selecting any one of them." The Committee would, of course, have been perfectly warranted in setting aside all the applications; but it was surely, to say the least, unwise thus to challenge criticism on the soundness of judgment of the Committee, since it is generally known that among the candidates was at least one who has had quite exceptional opportunities, not only for practical work, but also in teaching—Dr. Jas. Murie, who has been Demonstrator in Anatomy and Pathology to several medical schools both in Scotland and in London, has filled for some years the post of Prosector to the Regent's Park Zoological Gardens, and whose original papers and monographs (upwards of seventy in number) are universally recognised as evidence of quite unusual powers of research and demonstration. Our original workers are so few, and their opportunities of emolument so slender, that it is doubly hard that they should receive discouragement of this nature at the hands of a body specially bound to encourage the practice of original research.

At a meeting of the Bombay Geographical Society on October 16, it was resolved to make arrangements to amalgamate that Society with the Bombay branch of the Royal Asiatic Society.

The following are the names on the Cambridge Natural Science Tripos:—First Class—Whitmell (Trinity), Saunders (Down.), Teall and Yule (John's), the last distinguished in Comparative Anatomy and Physiology, and the last three equal. Second Class—Gaskell (Trin. H.), and Ranking (Cuth.), equal, Hebert, (Caius). Third Class—(all equal), Barron (Caius), Dew-Smith (Trin.), Knubley (Mag.), Marshall, W. C. (Trin.), Smith, J. (John's).

The elements of the new planet (No. 128), discovered on the night of Dec. 4-5, by M. A. Barrelly, are given in the last number of *Astronomische Nachrichten*. It is of the tenth magnitude.

The stations which the expeditions organised by the American government intend to occupy for the purpose of observing the transit of Venus will be mostly on the islands and coasts of the Pacific Ocean, from New Zealand on the south to the Aleutian Islands on the north, and from the Sandwich Islands on the east to China on the west. Telescopes and photographic apparatus for eight stations have been ordered from the firm of Alvan Clark & Sons, Cambridgeport, Massachusetts, and it is probable that nearly all the apparatus will be of American manufacture.

We regret to announce the death of W. J. Macquorn Rankine, on Dec. 24, 1872, Professor of Engineering in Glasgow University. We hope next week to give an account of his life and labours.

We regret to have to announce the death of Mr. Archibald Smith, LL.D., F.R.S., of Jordan Hall, Lanarkshire. Mr. Smith was born in 1814, studied at Glasgow and Cambridge Universities, being in 1836 Senior Wrangler and first Smith's Prizeman in the latter; the second wrangler was Bishop Colenso. He afterwards went to the Chancery bar, devoting his leisure to mathematical studies, his contributions to science being of high practical value. He was employed by Government to make a magnetic survey of the Antarctic regions, in connection with which he, in 1862, published his "Admiralty Manual for the Deviation of the Compass," which was republished and translated into various languages. Mr. Smith received from the Royal Society one of its Royal Medals, from the Emperor of Russia a compass set with diamonds, and recently from Her Majesty's Government a gift of 2,000*l.* as a mark of their appreciation of the value of his researches.

We learn that the Brighton Aquarium Company propose eventually to embrace in their building sections representing Zoology and Ornithology. There are now in course of construction a large tank for *Reptilia*, and a seal pond. On Monday last a fine young seal was brought from the London Zoological Gardens, and is now the centre of attraction to visitors. There are also some very fine specimens of Axolotl (*Axoloteles guttatus*) lately received from Mexico. Considering the short time the aquarium has been in working order, and the loss of the late manager, Mr. Lord, the present efficient state of the building reflects great credit on all concerned.

An examination will be held in Exeter College on Tuesday, January 28, 1873, and the following days, for the purpose of filling up four Scholarships and three Exhibitions. Two of the Scholarships are of the annual value of 80*l.* each, and two of them of 60*l.* each. To the latter, candidates born or educated for the three years last past in the diocese of Exeter have a prior claim, but only if they are duly qualified by their attainments to be scholars of the college. Otherwise these Scholarships also will be open. Of the Exhibitions one is worth 63*l.* per annum, the second is worth 50*l.* per annum, the third is worth 45*l.* per annum, and the holder of it, as also of the first, must apply himself to the study of Divinity. Candidates for the Scholarships must not have exceeded the twentieth year of their age on the day of election. There is no limit of age for the Exhibitions. One of the Scholarships and one of the Exhibitions will be given for proficiency in Natural Science, if sufficiently good candidates present themselves. Papers will be set in Chemistry, Physics, and Biology, but special weight will be given to excellence in Biology. Candidates in Natural Science must satisfy the College that they possess sufficient Classical knowledge to be able to pass responsions.

The exhibition for National Science at St. John's College, Cambridge (51*l.* for three years), has been awarded to Mr. W. B. Lowe, who was educated at Rugby, and Mr. Taylor equal. McAllister, who highly distinguished himself in the examination for this exhibition and in mathematics, was elected to one of 40*l.* for four years.

Mr. Dittmar, of Edinburgh University, has been appointed Assistant-Professor and Junior Demonstrator of Chemistry at Owens College, Manchester.

Mr. J. J. Taylor, of Giggleswick Grammar School, was elected on Wednesday, December 25, to a Natural Science Exhibition, at St. John's College, Cambridge, for proficiency in chemistry and physics.

Mr. Alexander Pedler, F.C.S., has been appointed Professor of Chemistry in the University of Calcutta.

We are favoured by Prof. Griffis with a copy of the *Japan Daily Herald*, which contains some notes of the ascent of the volcanic mountain Fuji Yama, on September 8 and 9, 1872, by an officer stationed at Subashiri. From his own very careful observations, compared with that of others, and corrected by instruments at the Lighthouse Department at Benten, the officer estimates the total height at 13,080·32 ft. The only vegetation found on the summit was small lichens, while icicles hung from the rocks all round. There are a few stone huts on the summit, in which people live during the summer. The sides are lined with woods, principally firs, larch, birch, and mountain ash. The approximate diameter of the crater is given as 1,770 ft., and its depth 440 ft. The bottom of the crater appeared to consist of a small patch of sand, though it might have been dirty snow. The sides are all loose clinker, affording no foothold, unless with the assistance of a rope.

The *Bulletin de la Société de Géographie* contains a paper by M. H. Duveyrier, on Livingstone's explorations, from 1866 to 1872, accompanied by a very pretty provisional map, which will no doubt require some alteration in the future. A paper on the Gulf Stream by M. E. Masqueroy, seeks to combat the theories advanced by Dr. Petermann in Nos. 6 and 7 of the *Mittheilungen* for 1870.

THE advanced sheet of the *Mittheilungen*, which Dr. Petermann has been good enough to send us, is occupied with an exceedingly interesting and carefully compiled abstract of the history of discovery in the most northerly region of Asia, between the Lena and Yenisei, from the year 1734 to 1866. This forms No. 73 of the papers on the geography and exploration of the Polar Regions, and is accompanied by one of those admirably constructed maps which form so enjoyable and valuable a feature of Dr. Petermann's invaluable periodical. The sheet also contains part of a second paper on Dr. Livingstone's exploration of the Upper Congo.

THE last number of *Le Tour du Monde* contains a "Revue Geographique" of 1872, devoted chiefly to African discovery.

AT a meeting of the managers of the Edinburgh Royal Infirmary, held on December 23, the following resolution was passed:—"That the managers of the Royal Infirmary resolve to admit females already enroled in the students' register for Scotland to receive clinical instruction, at a separate hour from that at which male students are admitted into the hospital, and in a stated number of wards, containing eighty beds, to which the female students must confine their visits; and remit to a subcommittee to make the requisite arrangements and alterations."

AT a meeting of the new Medical Microscopical Society held on December 6, Mr. Jabez Hogg was elected President, and a code of rules was adopted. The meetings will take place on the third Friday of each month, from October to July inclusive.

A MICROSCOPICAL *soirée* was given on the evening of Dec. 19, to the students of St. Thomas's Hospital, by the President and Secretary of the physical staff of that hospital (Mr. Wagstaffe and Dr. Evans).

WE learn from the *Athenæum* that the Earl of Derby would have formed one of the Arctic deputation, had he not been unavoidably detained in the country, and that he has expressed his cordial wishes for the success of the representation that has been made to Government.

THE *Revista del Sur*, of Chile, states that showers of sand occurred on July 3, in Araucaria, of sufficient extent to cover up all the planted fields of the Indians, and oblige them to take refuge on the north side of the mountain. This rain, supposed to have come from an eruption of Mount Llaima, distressed the Indians so much as to drive them into the neighbourhood of the white settlements.

THE Court of the Haberdashers' Company recently granted five exhibitions of 50*l*. each, for three years, to assist the holders (at Oxford, Cambridge, and London Universities) in their further educational or professional pursuits. Besides these exhibitions, 150*l*. was voted with a view to assist the education of children and grandchildren of liverymen. The same company has under its management five schools, new schemes for which are progressing with the Endowed Schools Commissioners.

THE November number of *Silliman's Journal* contains the first part of a very able paper by Prof. Joseph LeConte, in which he proposes his "Theory of the Formation of the great Features of the Earth's Surface." It is an admirable example of clear scientific reasoning and deserves the attention of all geologists, especially of those who believe the earth to be an extremely thin crust enveloping a molten and gaseous mass. He believes that Humboldt's formula, that all the effects of igneous agency are the result of "the reaction of the interior on the crust of the earth," must form the point of departure of every true theory; but in departing from this vague formula, only the most confused and contradictory notions seem to prevail among geologists. Mr. LeConte has for many years thought much on the subject, and his paper is an attempt to emerge from the chaos which now exists into something like clearness of perception on this supremely interesting point. He is convinced that the whole theory of igneous agencies—which is little less than *the whole foundation of theoretic geology—must be reconstructed on the basis of a solid earth*. Another very valuable article in this number is Mr. C. A. Young's "Catalogue of Bright Lines in the Spectrum of the Solar Atmosphere," which has already appeared in NATURE.

THE number of *La Revue Scientifique* for December 21, contains Prof. Hackel's introductory lecture on his taking possession of the chair of Zoology, recently founded in the University of Jena; the subject is "the Progress and Object of Zoology." The same number contains a notice of the institution recently founded at Haarlem, named "Bureau Scientifique central Néerlandaise," which proposes to do for Europe what the Smithsonian Institution does for America, effect with certainty, regularity, and a minimum expense, exchange of publications between the now very numerous European scientific societies. Any Society wishing to benefit by this mode of exchange, sends a sufficient quantity of its publications to the *Bureau*, which in return sends back to it copies of the publications of all the societies connected with it. At the end of the year the necessary expenses are divided among the various participating societies. The scheme looks plausible, and if well conducted might turn out to be very useful.

As usual at this season of the year the Royal Institution is doing its best to purvey for eager holiday-making youth a judicious mixture of the *utile* and the *dulce*, and as usual it has been eminently successful, if we may judge from the delight with which the hundreds of boys and girls who filled the well-known theatre last week listened to Prof. Odling's fascinating story of Air and Gas. It will be seen from our diary that the second and third on the same subject will be given on Tuesday and Thursday next.

THE *Scientific American* contains some interesting statistics concerning the extremes of heat to which various parts of the world are subject. Probably the hottest country is Thibet, though its most southern part is 30° from the equator, its extreme summer temperature reaching to the height of 150°. The fact that the night temperature, even in summer, sometimes sinks to the freezing point, only serves to aggravate the discomfort of this extreme heat. Next comes Senegal and Guadaloupe, with a maximum temperature of 130°, that of Persia being 125°, while the maximum of Calcutta and the delta of the Ganges is 5° less. In Cape Colony and the African diamond diggings the midsummer heat is 105°, that of Greece being only one degree less, while that of the comparatively far north city of Montreal is only one degree less than Greece, and one more than New York. In Great Britain, Siam, and Peru, the extreme does not exceed 85°, while that of Siberia is as high as 77°, two degrees higher than in Scotland, and four above that of Italy. In Patagonia and the Falkland Islands the highest is 55°, ten degrees above that of Southern Iceland. In Nova Zembla the maximum temperature is only 34°, two degrees above the freezing point of water.

WE learn from the *Times of India* that while Mr. T. T. Cooper is about to make another attempt to penetrate into China from Momein, the well-known French traveller, M. Garnier, who was the leader of the French expedition through Yunan into China, is about to start on another expedition from China through Thibet to India. M. Garnier has already left Hongkong for Shanghai to commence preparations for his journey.

WE have received the prospectus of a new monthly half-crown magazine, to be commenced in January, and which we are told, has already received a large number of subscribers. It is entitled the *Practical Magazine*, and will be supported by original contributions from the pen of distinguished writers on commercial subjects and applied sciences. It will also be an illustrated cyclopædia of industrial news, inventions, and improvements, collected from Foreign and British sources, for the use of those concerned in raw materials, machinery, manufactures, building, and decoration. It will carry out what is greatly needed—a careful and systematic survey of the industrial activities of America, Germany, and France; in order to present such information, as it is useful for British practical men to obtain, at the earliest possible moment. Judging from the prospectus it seems calculated to serve a very excellent purpose, and we heartily wish it abundant success. We have also received the first number of a new sixpenny monthly entitled the *Workman's Magazine*, published by Messrs. Kent and Co., and edited by the Rev. Henry Solly, and chiefly devoted to articles connected with the social condition of the class whom it addresses. The editor, we think, might find a corner for science, the influences of which are now felt among all classes.

MR. WILLIAM STOKES, JUN., surgeon to the Richmond Hospital, has been elected to succeed Mr. Hargrave as Professor of Surgery to the Royal College of Surgeons, Dublin.

THE *British Medical Journal* understands that the University of Dublin, the King and Queen's College of Physicians, and the Royal College of Surgeons, have agreed upon a scheme for a joint examining board. The Queen's University, however, and the Apothecaries' Hall still stand aloof.

THE *Journal of Horticulture* says that a French farmer has discovered that the use of tan is an efficient preventive against potato disease. For three years he has introduced a small quantity of the residue of the bark used in tanning into each hole on planting his potato crop, and each time he has been completely successful in preserving his fields free from the annoying disease.

WE have received the catalogue of the mathematical and scientific works of the library of the late Mr. Babbage, which are in the hands of Messrs. Sotheby, Wilkinson, and Hodge. If not sold by private contract before February 1, 1873, they will then be sold by auction. The collection is one of rare value, and its dispersion would be an event much to be regretted. The catalogue fills 190 pages, and does great credit to the compiler.

THE *feuilleton* of the number for December 28, of the *Gazette Médicale de Paris*, contains the concluding part of M. Dumas' admirable *éloge* on the late Isidore Geoffroy Saint-Hilaire.

WE learn from the *Engineer* that Mr. Eden, indoor engineer in the Edinburgh Telegraph office, has invented a system by which, with the existing instruments, it has been found practicable to send messages from both ends of a single wire simultaneously The invention has been tested between Edinburgh and Glasgow, and it has been found that one wire is capable of doing double work.

WE learn from *Ocean Highways* that considerable anxiety prevails in Sweden respecting the safety of the vessels attached to the expedition which were to have returned at the close of the navigable season. The brig *Gladan*, and steamer *Onkel Adam*, took out stores for the *Polhem*, and were to have returned before the winter set in. They are totally unprepared for wintering in the ice; and should they not be able to return, it will be necessary for the crews to abandon the vessels and take refuge in the *Polhem*, which in that case will be overcrowded, and crippled in her resources. The Norwegian Government has despatched to their relief the seal steamer *Albert*, which will make an energetic attempt to reach Spitzbergen. She takes out two wooden houses, to erect inshore at the most likely places for stragglers to find them, and abundant supplies.

TERRESTRIAL MAGNETISM *

I.

IN bringing before you this evening, gentlemen, the subject of terrestrial magnetism, it is not my intention to attempt to present you with an exhaustive paper on so wide a subject. It would be idle to pretend to give in a few short pages an adequate idea of all that has been ascertained on this subject, or even to present a satisfactory historical sketch of the progress made from earliest ages to the present time. Nor will I trouble you with a bare enumeration of the many facts, and methods, and theories that have gradually led scientific men to their present knowledge in this matter. But I will try rather to state, as clearly as I am able, what is the actual condition of our knowledge respecting the magnetism of the globe, and what the nature of its complex variations, without, however, entering much into details which, though they might perhaps be most convincing when reviewed at leisure, would be entirely out of place here, since they would only serve to encumber a paper intended for public perusal.

But, before treating of the special subject of terrestrial magnetism, allow me briefly to recall a few of the well-known properties of magnets.

That certain bodies possess the power of attracting iron was not unknown to the most ancient people; and men who had noticed this could not long have failed to observe the disturbing power that iron, in its turn, exerts upon the magnet when brought into its immediate neighbourhood.

But the duality of the magnetic force was doubtless a discovery of much more recent times, though now equally familiar as the former. That this twofold force ever seeks the opposite extremes, or poles, of a magnetic body, and that these poles, whilst possessing alike the power of attracting iron, are diametrically opposed in their action upon the poles of any other magnet, is expressed in the trite law that, "likes repel, and unlikes attract." Again, the law of magnetic intensity was unknown until the middle of last century, when it was found by Michell to be identical with that of universal gravitation, namely, to diminish inversely as the square of the distance of the body attracted. That this was not discovered at an earlier date is partly due to the complexity of the phenomena arising from the duality of the force, combined with the inseparable nature of the two energies. For, unlike electricity, to which in most other points it is so near akin, neither the positive nor the negative element of magnetism can ever exist alone in any body.

Now, since we know that magnets and iron act mutually upon each other, and that one magnet attracts or repels any other according to certain fixed laws, if we remove all disturbing bodies from the vicinity of a magnet, and leave it perfectly free to move by floating it on a liquid, or suspending it by a thread, we might expect to see the magnet remain at rest in whatever position we place it. But we perceive at once that this is not the case, and the magnet we thought to be free is found to be subject to a directive power, which forces it to take a fixed direction, without in the least interfering with the position of its centre of gravity. Disturb the magnet, and when it comes to rest it will again lie in the same direction as before. The earth, therefore, exerts a certain influence on the magnet, not producing any translation from one position to another, but only forcing the poles of the magnet to assume a definite direction. That this power possessed by the earth is precisely similar to that of an ordinary magnet, is easily shown by counteracting the earth's action by means of a magnet, placed at a suitable distance from the free magnetic needle, and with its marked end in the same direction as that of the needle, the latter will then rest in any position in which it is placed.

This polarity, or directive power of the earth, is said to have been known to the Chinese 1,000 years at least before the Christian era, and to have aided them in their long journeys across the trackless wastes of their vast empire. The use that has since been made of this simple fact, the growth of commerce, the spread of civilisation, and the thousand other blessings that it has brought to our very doors, need no long comment here. We may well marvel that such a source of wealth and prosperity was allowed by mankind to remain almost fruitless during such a long succession of ages.

The horizontal direction taken by the freely suspended needle is nearly north; but it generally deviates somewhat from the astronomical meridian. This deviation is termed the declination or variation of the compass. The existence of the declination was not unknown in remotest times, although its discovery is sometimes erroneously attributed to Christopher Columbus. To this great man we are, however, indebted for our knowledge of "the variation of the variation," since he was the first who noticed its change as he altered his geographic position in his great voyage of discovery across the Atlantic.

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* By the Rev. S. J. Perry, F.R.A.S., F.M.S., Director of the Stonyhurst Observatory. Extracted from the *Journal of the Liverpool Polytechnic Society*, by the permission of the Council. Communicated by the author.

The first and most important fact in terrestrial magnetism, viz., the declination or horizontal lie of the freely suspended magnet, being established, we may take an unmagnetised piece of iron, similar in weight and form to our magnet, and balancing it on an axis passed through its centre of gravity, allow it to rest on the extremities of this axis. We shall find that the unmagnetised needle will remain at rest in whatever position we choose to place it, since we have taken care to suspend it by its centre of gravity. But if we now substitute the magnetised instead of the unmagnetised needle, and place it in the plane of the horizontal magnet, we shall perceive at once that at whatever angle we place it on its supports it will invariably take up a definite position with respect to the horizon, the marked end, which points W. of N., dipping down until it stands in this country at an angle of about 70° to the horizon. The earth, therefore, not only tends to bring the magnetic needle into a certain azimuthal plane, but it also forces it to take a fixed position in that plane. The direction of the magnet is thus wholly determined by the earth's magnetic force.

Our next care will, therefore, naturally be to discover, if possible, what is the intensity of this terrestrial force which acts upon the needle. This might be determined by finding the resistance it is capable of overcoming, or the weight it will balance, the weight being attached to a thread wrapped round the axis of the needle. But the intensity of the earth's pull is more accurately found by a method similar to that which has been used with such success in observing the force of gravity at different points of the surface of the globe, in view of ascertaining the amount of its compression. A magnetic needle is suspended by a thread, from which all torsion has been removed, and then an oscillatory movement at right angles to the plane of minimum dip is imparted to the needle in such a manner as to leave the point of suspension at rest. The square of the time of a single oscillation is a sure measure of the intensity of the force producing the vibration, which in this case is the product of the magnetism of the needle by the horizontal component of the earth's magnetism. The factor due to the magnetic strength of the needle can be eliminated at once if the power of our needle is known, and the horizontal component of the terrestrial magnetism divided by the cosine of the dip of the needle will then give the required total intensity. But if the power of the magnet is unknown, and on account of slight but continual changes, it is always safest to consider it as doubtful within certain limits, the quotient of the earth's horizontal force by the magnet's power can easily be found by measuring the deflection of a free magnet produced by the attraction of the vibration needle at given distances. The result of these experiments is to place in evidence that the intensity of the earth's magnetism follows laws as constant as those of its directive force.

Having thus made ourselves acquainted with the three essential elements of the magnetism of our globe, viz., the dip and declination, which determine the direction, and the third, which expresses the intensity of the attracting force, our next step in the study of the earth's magnetism, as a whole, is to secure the most trustworthy observations of these three elements at as many different stations as possible. The instruments used must be of the most delicate description, as the differences to be measured are often excessively minute. For this purpose the needles are suspended by the slenderest thread of unspun silk, or the smoothest axis rests on knife edges of polished agate. The care with which the observations have to be taken may be judged of from the fact that, to obtain the time of a single vibration of the needle, twelve sets of 100 or 200 vibrations are taken, and each estimated to the twentieth of a second; or, again, for a single observation of the dip, the needle, which is balanced by the maker with scrupulous care, is so far suspected that readings are taken of each end, the needle is turned on its Ys, the whole instrument is reversed, and finally the poles are altered, and each of these readings repeated at least twice before the observer has satisfied himself that all necessary caution has been taken to secure a perfect observation. An apparatus of greater delicacy than those in general use has lately been invented by Dr. Joule, of Manchester, which we may hope will furnish results of still greater accuracy than those already obtained.

'Twas not until towards the middle of the sixteenth century that accurate determination of any of the magnetic elements were attempted; but since that time the declination has continued to be observed with some regularity, and before the end of the seventeenth century Halley had already made two long voyages to observe this element at different parts of the globe.

The dip, whose discovery is due to Norman, was first observed in 1576, but it does not seem to have attracted much attention until two centuries later.

The determination of the intensity, by means of the vibrations of a magnet, was first suggested in the last century by Graham, and the first maps of the isodynamics, or curves of equal intensity, are the fruits of the labour of General Sir Edward Sabine, who is now devoting the declining years of his life to the publication of the results of his life-long study of terrestrial magnetism.

From the above observations of the three magnetic elements, taken at different positions on the surface of the globe, the first general conclusion we are able to draw is one of no little importance. For, starting from any point of the earth, and following the direction of the horizontal needle, we are invariably led to one or other of two points, situated respectively in the Northern and Southern hemispheres. The entire globe is, therefore, traversed from N. to S. by a system of magnetic lines, all meeting in the same two points, resembling in this respect our geographical meridians and poles, and therefore termed the magnetic meridians and the magnetic poles of the earth. Our second conclusion is of scarcely inferior importance to the first. For if, instead of following the direction of the horizontal needle, we carefully observe the dip, and travel along the line, where we find the inclination invariable, we shall always be led, not up to a magnetic pole, but in a more or less circular path around the pole. These curves of equal dip, generally called isoclinals, bear a close resemblance to our geographic parallels of latitude; and as the geographic latitude varies from zero at the equator to 90° at the poles, so in like manner the dipping needle, which is horizontal at the magnetic equator, gradually increases its inclination until it becomes vertical at the magnetic poles.

From these angles of position of the dipping needle we can conclude at once that the horizontal component of the earth's magnetism must be zero at the poles, and probably maximum at the magnetic equator, where the terrestrial force is wholly horizontal.

We may, therefore, describe the magnetic poles in the words of the Astronomer Royal, "as the common points for the convergence of magnetic meridians, for the verticality of the dip, and for the evanescence of the horizontal force."

But there are other points on the earth's surface which merit our most special attention. I will not call them poles, as they have little in common with the two poles of which we have just been speaking, but I will describe them as points of maximum intensity. The isodynamics, or lines of equal intensity, are not found to follow such simple laws of distribution as the meridians and the lines of equal dip and horizontal force, though these latter are far from being arranged with the same regularity as the meridians and parallels of latitude of a geographic globe. None of the magnetic curves are perfect circles, the poles are not coincident with the geographic poles, nor are they opposite to each other, one being situated north of Baffin's Bay, and the other in South Victoria, but still there is a general approach to regularity in the magnetic lines, if we except the isodynamics, and the law of variation of the dip was found to be fairly represented by the formula, $\tan. \delta = 2. \tan. L$ (the magnetic latitude), a law discovered by Krafft in 1809. The greatest departure from the general regularity of the curves we have been mostly considering, is the indication of a second pole in the Southern Hemisphere from the peculiar distribution of the lines of equal horizontal force. But in the case of the isodynamics we find three well-marked points of maximum intensity, one N.W. of Hudson's Bay, another in Siberia, and the third not far from the South magnetic pole in Victoria. Besides these there are also two maxima of small intensity, one situated slightly north, and the other at about 15° S. latitude. We are still, however, able to trace a rough approximation to a law in the change of the intensity, the value at the principal maximum being about double what is found to be on the curve of minimum intensity.

The distinction between points of maximum intensity and the true magnetic poles has not always been attended to with sufficient care, and this is partly to be accounted for by the considerable and often preponderating influence of these maximum points on the several magnetic elements. A consequent doubt was for a long time entertained respecting the number of the magnetic poles. Halley, from a careful study of an extensive series of declination observations, made partly by himself in 1698-9, was led to the conclusion that the earth has four magnetic poles. The same opinion has been most ably advocated within our own days by Prof. Hansteen of Christiana, who had previously collected together a vast mass of observations of the declination, dip, and horizontal force. But the interesting series of results which Hansteen has brought forward in support of his view, are most readily explained by the evident changes that have taken place in the magnetic state of the region of maximum intensity situated in Siberia, where Hansteen himself specially observed. The Northern regions, where the magnetic force is greatest, abound in ferruginous strata, and there too the intensity of the cold far exceeds anything that is experienced in other lands on the same parallel of latitude. These regions may therefore not only be charged with a most abundant supply of permanent magnetism, but they may also be affected to a very considerable degree by atmospheric changes, and by those electric currents that are continually passing to and fro in the upper crust of the earth, and are doubtless producing very important changes in the subpermanent magnetism of certain layers of softer ferruginous matter. Whatever may be the nature of terrestrial magnetism, we cannot ignore the great influence exercised on its distribution by what may be termed local magnetism, the magnetism of volcanic formations, of mountain chains, of ferruginous beds; some harder than others and therefore less subject to magnetic influence, but retaining its effects the longer; some more affected by the extremes of heat and cold, and hence exposed to more rapid and radical changes in their magnetic condition.

But the question of the number of magnetic poles is leading us to another point of scarcely less importance, viz., the investigation of the changes that take place in the magnetism of the globe. The first point of inquiry is whether terrestrial magnetism as a whole is subject to continual change, and if so, are these changes periodical? Do they move in cycles? Do they follow any fixed laws that may lead to a knowledge of their causes?

The difficulty in answering these questions arises mainly from the irregular distribution of the points of maximum intensity; but, granting that we meet with numerous exceptional cases, which no doubt will finally be discovered to depend on local influences, we can trace a very regular and periodic change in all the magnetic elements.

The first accurate observations that have come down to us are those of the declination, or variation of the compass, taken in Paris in 1541, when the needle pointed 8° to the east of the astronomical meridian. From that period the easternly deviations gradually increased, until it attained a maximum value of 11° 30′ in 1580, when it returned slowly on its path and vanished in the year 1660, Paris being then on the curve of "no variation." Pursuing its westernly course, the needle pointed more and more west of north each year, and only reached its greatest western elongation of about 23° in 1814. The needle is at present returning towards the east, at the yearly rate of about 9′·5, and actually points rather less than 17° west of north. The variations of the declination at London have followed much the same order as those at Paris, nor has there been any great difference in the extent.

The dip observations have unfortunately not been carried on so continuously during such a long series of years, and in consequence the secular variation of this element is less well determined than that of the declination. With the exception of a single observation by Norman in 1576, who found the inclination of the needle at London to be 71° 50′, we have scarcely any reliable data previous to 1720, when the dip had increased in London to 74° 42′. Since the latter epoch this element has always continued to decrease, being 70° 35′ in 1800, and now less than 68°, with an annual diminution of about 2′·5.

Of the secular variation of the intensity we know even less than of that of the dip, since the first observations date only as far back as the end of the last century; and we have no less an authority than that of Sir Edward Sabine for the statement, that "at commencement of the present century the bare fact of there being any difference whatsoever in the intensity of the magnetic force in different parts of the earth was unattested by a single published observation." The results, however, of modern research supply us with the important fact that the horizontal component of the intensity is at present rapidly increasing, its yearly rate of change being one 600th of its total value.

Now each and all of these gradual variations in the several elements of the earth's magnetism force upon us the conclusion that the magnetic pole must be endued with a motion of rotation in a more or less circular path around the pole of the earth's axis. The results of such a rotation apparent to an observer situated for example in England will be easily understood if we consider for a moment the similar movement of any of the inferior planets in its orbit round the sun as viewed from the earth. Take Venus, for instance, which is the most conspicuous of the planets. At one time it may be seen moving away from the sun towards the east, when it is called the evening star, since it sets later than the sun. This outward movement continues for a time, until the planet reaches the point of its maximum elongation; it then returns towards the sun, and after a time becomes lost to sight in the brilliancy of the solar rays, or on very rare occasions is visible in transit over the solar disc, as it will be for the first time this century in 1874, and again in 1882. Having passed the sun, Venus becomes the morning star, rising earlier and earlier until it has attained its greatest western elongation, when it again returns towards the sun. An analogous movement of the magnetic pole around the geographic pole has been clearly indicated by the secular variations of the declination, dip, and horizontal force. At the middle of the 16th century the bearings of the needle which would lead us to the magnetic pole were some 10° east of north. As time went on this deviation diminished, whilst the dip increased, showing that the magnetic pole was approaching us, as it got nearer and nearer to the meridian. About the middle of the 17th century, or rather somewhat later, the magnetic pole crossed our meridian, which thus for the moment partly coincided with the "line of no variation." From that time the needle has always pointed west, the western declination increasing more and more until the pole reached its maximum elongation in 1815. During this period there was a gradual decrease in the dip, manifesting a recession of the pole, and this has continued steadily, though with diminished acceleration, ever since the needle commenced its backward journey towards the geographic meridian. The present secular increase of the horizontal force also shows that the pole is receding, and that it will cross our meridian next on the further side of the geographic pole. This will take place, according to the calculation of M. Quetelet, director of the Brussels Observatory, about the year 1940, and thus a complete revolution of the magnetic pole will occupy a period of some 560 years. Other physicists make this period longer. Local magnetism must of course interfere greatly with the position of the pole, and with its velocity of revolution, but this disturbing cause will affect still more the movements or form of the "curve of no variation."

This rotation of the magnetic pole round the extremity of the earth's axis bears so striking a resemblance to the motion of the pole of the heavens round the ecliptic, that we are led at once to inquire if anything can be detected in the magnetic rotation that corresponds with the inequalities in the precession of the earth's axis, with the nutation caused by the action of the sun and moon. Are there, in other words, any annual, semi-annual, or monthly inequalities? The observations of the declination, taken during a series of years, and grouped together according to months, led to a variety of conclusions respecting the influence of the sun on the deflection of the needle. Arago agreed with Cassini in placing the sun in the vernal equinox at the maximum western variation, and in the summer solstice at the minimum; whilst Bowditch, in America, and Beaufoy, in England, both found that a maximum occurred in August and a minimum in December, though a second maximum and minimum were placed by each in different seasons. The fact of some yearly range of the needle about its mean position appeared to be established; but local influence seemed to have a large share in determining the nature of the annual curve.

(To be continued.)

SCIENTIFIC SERIALS

THE *Geological Magazine* for December (No. 102) opens with a description by Mr. James Cartro of a new genus and species of fossil crustacea from the Upper Greensand of Lyme Regis, which the author proposes to name *Orithopsis Bonneyi*. The fossil which appears to be nearly allied to *Necrocarcinus*, is figured on a plate accompanying the paper. Mr. C. Lapworth communicates a note on the Graptolitic black shales of the south of Scotland, in which he reiterates his opinion that there si but a single group of these shales, divisible, however, into three divisions—the Lower, Middle, and Upper Moffat shales. The first he regards as of Lower Llandeilo age, the second as equivalent to the Upper Llandeilo of Builth, and the third as Caradoc.—From Mr. S. Allport we have a valuable paper on the microscopic structure of the pitchstones and felsites of the island of Arran, in continuation of a former note published in the *Geological Magazine*. The number also contains a reprint of an interesting paper by Dr. Carpenter on the temperature and other physical conditions of inland seas, in their relation to geological inquiry.—Among the reports, &c., we find Mr. Woodward's sixth report on fossil crustacea, presented to the last meeting of the British Association. This contains a genealogical tree of the Crustacea.

Annalen der Chimie und Pharmacie, Nos. 11 and 12, 1872.—This double number contains a paper by Dr. Abeljanz on bichlorether, in which some of Lieben's results are called in question. The writer discusses chiefly the preparation of bichlorether, the action of pentachloride of phosphorus upon it, and its decomposition by water and by alkali.—In an essay on diphtalyl, Dr. Ador describes the preparation of this substance, through the action of finely-divided silver on dyphtalyl chloride. It has the formula $C_8 H_4 O_2$. It is insoluble in water, and soluble largely only in heated phenol and cold concentrated sulphuric acid. It fuses at 300°. The action of alkalies on dyphtalyl, dyphtalyl acid, its salts, and capability of oxidation, action of pentachloride of phosphorus and bromine on diphtalyl, and some of the by-products of preparation are among the points taken up.—J. Wislicenus communicates some observations on the so-called anhydrides of lactic acids. He finds that before all the water is evaporated from a solution of lactic acid, some anhydride is always present (with the acid), the quantity of which increases with the decrease of the water, and that, therefore, pure lactic acid of the formula $C_3 H_6 O_3$ does not exist. Further, that when lactic acid is kept in a dry atmosphere at ordinary temperature, there is formed not only the so-called anhydride, but also a lactide.—Th. Zincke and A. Franchimont describe nonylic acid, a colourless oily fluid, having the formula $C_9 H_{18} O_2$, boiling about 253; specific gravity at 17·5° = 0·9065. It is little soluble in water, but distils slowly over with the vapour of boiling water. At a low temperature it solidifies to a crystalline mass, and it melts at + 10°.—Among the remaining papers in this number are lengthy monographs on some of the cyanogen derivatives of aceton, by Dr. F. Urech, and on the reduction products of silicic acid ether and some of its derivatives, by A. Ladenburg; also notes on the action of sodium on dibrombenzol, by Dr. Riese, and the constitution of sodium ethylate, by A. Laubenheimer.

Nos. 3 and 4 of the *Proceedings of the Swedish Academy of Sciences* for the present year, contains the proceedings of the Academy for March and April. The first paper is an account of an experimental investigation upon the electromotive and thermo-electric forces of certain metallic alloys in contact with copper, by M. A. F. Sundell. The alloys employed in these experiments consisted of bismuth and tin, and bismuth and antimony in various proportions, and of a white metal (*Nysilven*) the composition of which is not given. The action of bismuth is lessened in proportion to the amount of tin, and also by $\frac{1}{32}$ of antimony, but increased by $\frac{3}{32}$ of the latter metal. Iron is very low in the scale, which is similar for the electromotive and thermo-electric powers of the different metals and alloys.—Dr. C. Stål communicates a synopsis of the European genera of Pentatomidæ in Latin, from which, curiously enough, the Cydnina are omitted.—Dr. H. D. J. Wallengrew furnishes a further contribution to the Lepidopterous fauna of South Africa, founded upon a small collection sent home by M. Akerberg, Swedish Consul at the Cape. His list, which includes species belonging to the groups from the butterflies to the Crambidæ, numbers seventy-one species, several of which are described as new, whilst descriptions and notes on synonymy are appended to many of the others. A new genus of Lycœnide butterflies, *Arrugia*, is proposed for *Zerythis basuta* Wall, *protumnus* Lin. The new species are all Geomitrina,—they are *Conchylia pactolaria, Camptogramma quaggaria, C. sylvicultrix, Macaria grimmia, M. getula, Tephrina nemorivaga, Panagra platyrhyncata, P. octomaculata and Mesotype textilis.*—A new species of mica called Manganophyll, from the iron and manganese mines of Paysberg in Wermland, is described by M. L. J. Igelström,—It contains 21·40 per cent. of protoxide of manganese, and varies from bronze to bright copper colour.—Prof. Angström enumerates and describes some mosses and Hepaticæ collected by Prof. N. J. Anderson, during the voyage of the frigate *Eugenie*, in 1851-53. The specimens are from Port Famine, from near Wollongong in Australia and from Honolulu. A great many of them are described as new species, and these belong to the genera *Gymnostornum*, *Orthotricum*, *Dicranum*, *Tortula*, *Bartramia*, *Gottschea*, and *pungermanina* (from Port Famine), *Thamnium* and *Lejeunia* (from Wollongong) *Hypnum*, *Plagiothecium*, *Omalia*, *Campylopus*, *Macromitrium*, *Fissideus*, *Jungennanina*, *Shagnœclis*, *Lejeunia* and *Frullania*, (from Honolulu). M. C. A. F. Sädbour notices the nocturnal migratory habits of *Myodes schisticolor* Lilljeb. The number concludes with a report by the secretary on the activity of the Academy during the year 1871-72.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 13, 1872.—"Researches in Spectrum Analysis in connection with the Spectrum of the Sun."—No. I. By J. Norman Lockyer, F.R.S.

The author, after referring to the researches in which he has been engaged since January 1869 in conjunction with Dr. Frankland, refers to the evidence obtained by them as to the thickening and thinning of spectral lines by variations of pressure, and to the disappearance of certain lines when the method employed by them since 1869 is used. This method consists of throwing an image of the light-source to be examined on to the slit of the spectroscope.

It is pointed out that the phenomena observed are of the same nature as those already described by Stokes, W. A. Miller, Robinson, and Thalen, but that the application of this method enables them to be better studied, the metallic spectra being clearly separated from that of the gaseous medium through which the spark passes. Photographs of the spark, taken in air between zinc and cadmium and zinc and tin, accompany the paper, showing that when spectra of the vapours given off by electrodes are studied in this manner, the vapours close to the electrode give lines which disappear from the spectrum of the vapour at a greater distance from the electrode, so that there appear to be long and short lines in the spectrum.

Maps of the following elements have been mapped on this method:—Na, Li, Mg, Al, Mn, Co, Ni, Zn, Sr, Cd, Sn, Sb, Ba, and Pb, the lines being laid down from Thalen's maps, and the various characters and lengths of the lines shown.

In some cases the spectra of the metals, enclosed in tubes and subjected to a continually decreasing pressure, have been observed. In all these experiments the lines gradually disappear as the pressure is reduced, the *shortest lines disappearing first, and the longest lines remaining longest visible.*

Since it appeared that the purest and densest vapour alone gave the greatest number of lines, it became of interest to examine the spectra of compounds consisting of a metal combined with a non-metallic element. Experiments with chlorides are recorded. It was found in all cases that the difference between the spectrum of the chloride and the spectrum of the metal was, that under the same spark-conditions all the short lines were obliterated. Changing the spark-conditions, the final result was, that only the very longest lines in the spectrum of the metallic vapour remained. It was observed that in the case of elements with low atomic weights, combined with one equivalent of chlorine, the numbers of lines which remain in the chloride is large, 60 per cent. *e.g.*, in the case of Li, and 40 per cent. in the case of Na; while in the case of elements with greater atomic weights, combined with two equivalents of chlorine, a much smaller number of lines remain—8 per cent. in the case of barium, and 3 per cent. in the case of Pb.

The application of these observations to the solar spectrum, to elucidate which they were undertaken, is then given.

It is well known that all the known lines of the metallic elements on the solar atmosphere are not reversed. The author states what Kirchhoff and Angström have written on this subject, and what substances, according to each, exist in the solar atmosphere. He next announces the discovery that, with no exception whatever, *the lines which are reversed are the longest lins.* With this additional key he does not hesitate to add, on the strength of a small number of lines reversed, zinc and aluminium (and possibly strontium) to the last list of solar elements given by Thalen, who rejected zinc from Kirchhoff's list, and agreed with him in rejecting aluminium. It need scarcely be added that these lines are in each case the longest lines in the spectrum of the metal.

The help which these determinations afford to the study of the various cyclical changes in the various solar spectra is then referred to.

Geological Society, Dec. 18.—Mr. Warington W. Smyth, F.R.S., vice-president, in the chair.—The following communications were read:—"Further Notes on the Punfield Section," by C. J. A. Meyer. This paper was supplementary to one read before the society by the author in March of the present year (see "Quart. Journ. Geol. Soc." xxviii. p. 245), and contained the results of a fresh examination of the section at Punfield, and of the Wealden and Neocomian strata of the Isle of Wight. He described the section exposed at his visit to Punfield as presenting:—1, True Wealden beds; 2, a grit-bed with limestone and paper-shales, containing fish-bones and Cyprides; 3, apparently argillaceous beds; 4, a thin band of hard ferruginous sandstone with Atherfield fossils; 5, a clay bed, the upper part regarded as representing the "Lobster Clay" of Atherfield, the lower sandy portion containing an abundance of marine fossils belonging to common Atherfield species; 6, the so-called "marine band;" and 7, laminated clays and sands with lignite. The author indicated the accordance of this arrangement with what is observed elsewhere, and maintained that the grit-bed (No. 2), with its limestone and paper-shales, containing *Cypris* and *Cyrena*, was really to be regarded as the passage-bed between the Wealden and the Neocomian.—"On the Coprolites of the Upper Greensand Formation, and on Flints," by W. Johnson Sollas. The first part of this paper was principally occupied in an endeavour to explain the perfect fossilisation of sponges and other soft-bodied animals It was shown that the hypothesis which considered that sponges had become silicified by an attraction of their spicules for silica was altogether untenable. Mr. H. Johnson's supposititious reaction, according to which the carbon of animal matter is directly replaced by silicon, was shown to be inconsistent with the known facts of chemistry. The author's explanation was not intended to be final. The first fact pointed out was the very remarkable way in which the silica or calcic phosphate of the fossils under consideration followed the former extension of organic matter. This was explained for silica by the fact that, when silicic acid is added to such animal matters as albumen or gelatin, it forms with them a definite chemical compound; and it was assumed that in process of time this highly complex organic substance would decompose, its organic constituents would be evolved, and its silica would remain behind. In such a way flints might be produced, and dialysis would lend its aid. The same explanation was applied to account for the connection between calcic phosphate and animal matter in the case of the "Coprolites." The Blackdown silicified shells were next explained, and it was reasoned that the state of their silica offered arguments tending to prove a passage of silica from the colloidal to the crystalline state. The second part of the paper discussed the Coprolites specially; their exterior appearance is extremely sponge-like, almost exactly resembling some species of modern sponges. They are marked by oscules of peculiar characters. The so-called "pores" of palæontologists are well marked. Spicules, triradiate, hexradiate, sinuous, defensive and connecting, have been observed. They are siliceous in composition. On dissolving the coprolites in acid, the spicules are set free, associated with *Polycystina* (*Haliomma hexacantha*, &c.) and *Xanthidia* (*N. furcatum*). The genera and species of coprolites described were as follows:—*Rhabdospongia communis*, *Bonneyia bacilliformis*, *B. cylindricus*, *B. Jessoni*, *B. scrobiculatus*, *B. verrongiformis*, *Acanthophora Hartogii*, *Polycantha Etheridgii*, *Retia simplex*, *R. costata*, *Ulospongia patera*, *U. calyx*, *U. Brunii*. The external appearance of these forms, which constitute a vast number of the coprolites, their curious oscules and siliceous spicules, were said to leave no doubt as to ther spongious origin.

Chemical Society, Dec. 19.—Prof. Williamson, F.R.S., vice-president, in the chair.—Analyses of water of the river Mahanuddy, by Mr. G. Nicholson. The author finds that the water of this river contains less dissolved matter than that of any other river in India.—Researches on the polymerides of morphine and their derivatives, by Mr. E. Ludwig Mayer and Dr. C. R. A. Wright; an account of the various derivatives obtained from morphine by acting on it with zinc chloride, hydrochloric acid, and sulphuric acid respectively, and also of the physiological properties of the compounds produced.—Three communications by Dr. H. E. Armstrong, from the laboratory of the London Institution, were then read. Derivatives of β-dinitrophenol; note on the action of bromine in presence of iodine on trinitrophenol (picric acid); preliminary notice on iodonitrophenols. The last paper, by Mr. C. E. Groves, was on the formation of napthaquinone by the direct oxidation of napthaline, which the author effects by means of chromic anhydride.

Anthropological Institute, Dec. 17.—Dr. Charnock, vice-president, in the chair. A paper was read by Mr. C. Staniland Wake on the origin of serpent-worship. After referring to various facts showing the existence of serpent-worship in many different parts of the world, the paper proceeded to consider the several ideas associated with the serpent among ancient and modern peoples. One of its chief characteristics was its power over the wind and rain. Another was its connection with health and good fortune, in which character it was the *Agathodæmon*. The serpent was also the symbol of life or immortality, as well as of wisdom. It was then shown that that animal was viewed by many uncultured peoples as the re-embodiment of a deceased ancestor, and that descent was actually traced by the Mexicans and various other peoples from a serpent. The serpent superstition thus became a phase of ancestor worship, the superior wisdom and power ascribed to the denizens of the invisible world being assigned also to their animal representatives. When the simple idea of a spirit ancestor was transformed into that of the Great Spirit, the father of the race, the attributes of the serpent would be enlarged, and it would be thought to have power over the rain and the hurricane, which provide the moisture requisite for life. Being thus transferred to the atmosphere, the serpent would come to be associated with nature, or solar worship. Hence we find that the sun was not only a serpent-god, but also the divine ancestor or benefactor of mankind. Seth, the traditional ancestor of the Semites, was the serpent-sun-god, the *Agathodæmon*, and facts were cited to establish that the legendary ancestors of the peoples classed together as Adamites was thought to possess the same character. It would appear to follow from this and other facts mentioned in the paper that serpent worship, as a developed religious system, originated in Central Asia, the home of the great Scythic stock from which the civilised races of the historical period sprung, and that the descendants of the legendary founder of that stock, the Adamites, were in a special sense serpent-worshippers.—Major W. H. Godwin-Austin contributed a paper "On the Garo Hill Tribes." The Garos occupy the extreme west point of the range of hills south of the Brahmaputra, and which terminate with the great bend of that river on long. 90° east. The paper entered into a comparison of the Garos with the kindred tribes of Duars, Kackari, and Kopili; and gave detailed descriptions of the physical characteristics, religious rites, manners, and customs, and peculiar dwellings of that people.

VIENNA

I. R. Geological Institute, Nov. 19.—The first meeting of the winter season was opened by the director, Fr. v. Hauer, with the report on the progress of the geological survey made during last summer. It was carried on in three different regions in the north-western part of Tyrol and Vorarlberg, including also the dominion of Prince Liechtenstein, on the Carlstadt military frontier, and in the south part of Bukowina. The exact investigation of the limestone chain in the first region, by Dr. v. Majsisovics, gave very unexpected results; not only did he discover Silurian (Grauwacke) strata and dyassic strata (Schwatz-limestone and Gröden-sandstone) unknown hitherto in the Rhäticum, but he stated also that the large limestone range of the Drusenflah, Salzflah, and Weisplatten belongs to the cretaceous formation—a very important fact, which changes essentially our ideas as to the geological structure of the curious region which separates the eastern and western Alps. Not less important are the observations of Dr. Stache on the crystalline rocks of the Oetzthal massive. He denies the existence of any more recent and eruptive "Central Gneiss" in this region, and asserts that strata of the so-called rock alternate regularly with mica-schist, amphibolic schists, &c. in the middle part of the massive as well as towards its outer margins. In the southern part of Bukowina, a region very little known till now, Mr. Paul stated that the crystalline schists, forming the basis of a series of sedimentary formations, are divisible into two members; the lower, consisting chiefly of quartz-slates and quartzites, contains ores of copper and iron; the upper, formed by mica-slates, red gneiss, calcareous and amphibolic slates, includes the so-called black iron ores and manganese ores of Takobeni and Dorna. The sedimentary rocks are red sandstone, triassic limestone, lower and upper Neocomian, Cenomanian, Nummulitic rocks, and higher up the large masses of Carpathian sandstone. Besides the regular survey, almost all the members of the Institute made particular inquiries in different parts of the empire, partly for exclusively scientific purposes, but chiefly for the solution of questions of practical interest. An important discovery was thus made by Dr. Stache; he found in the slates south of the Gaiethal in Carinthia numerous Graptolites, the first certain proof of the existence of Silurian rocks in the southern Alps.

PARIS

Academy of Sciences, Dec. 16.—M. Faye, president, in the chair. The president of the Institute informed the Academy that its first general meeting for 1873 would be held on January 8, and wished the Academy to appoint a member to represent it as reader on that occasion.—General de Cissey, Minister of War, announced that his department had decided on the re-determination of the French meridian which has at present many errors, as it is advisable that the French section of the great line extending from Shetland to the Sahara should equal in accuracy the English, Spanish, and Algerian portions. Captain Perrier is to have charge of the work, and the Academy is asked to appoint a committee of revision.—The president then read an addition to his physical theory of the sun explaining the nature of the spots He defends his theory against some recent criticisms of Messrs. Spencer and Kirchhoff. He regards the spots as produced by cyclones which form a funnel-shaped cavity in the photosphere. Round the edge of this hole the photosphere and chromosphere are heaped together, and into it masses of cooler atmosphere are drawn by the vortex, and they then exert their absorptive power.—M. Jamin read a note on the distribution of magnetism.—M. Belgrand then read a second note on the floods of the Seine—M. Daubrée read a note on a meteorite which fell near Bandong, Java; the governor of the Dutch Indies had sent a portion to the museum. An analysis has been published in the Archives Néerlandaises of Haarlem, vol. vi. 1871, by Mr. Von. Baumhauer. The meteorite contains iron, nickel, cobalt, chromium, manganese, magnesium, aluminium, sodium, potassium, calcium, oxygen, sulphur, and silicon.—M. Fréd. Kuhlmann then read an account of a search for iodine and bromine in some phosphatic minerals, iodine was distinctly recognised, but bromine if present was only there in inappreciable quantities.—M. F. Perrier read a note on a new determination of the French meridian.—The *Phylloxera* Commission presented extracts from two papers by MM. Max Cornu and E Duclaux: they also asked permission to present their report at an early date. Notes on the same subject were received from MM. R. Shore and Alderly.—M. de Wissocq presented a paper entitled "A Study of the Works required to prevent the Floods of the Loire.—M. Sacc sent a letter on the preservation of food, which was referred to the commission on that subject.—M. F. Perrier read an answer to a note of M. Laussedat on the prolongation of the Spanish meridian into Algeria. The answer related partly to questions of priority as concerns the proposed prolongation.—M. F. Lucas presented some observations on a note on mathematical physics, by M. Quet.—M. Gernez sent a note on the supposed action of thin films of liquids on supersaturated solutions. The author asserts that Tomlinson and Van der Mensbrugghe are deceived in their idea that films cause crystallisation. M. Gernez states that this is not caused by a film *per se*, but by crystalline particles contained in it.—M. A. Trève read a note on magnetism, which was followed by a note by MM. Troost and Hautefeuille on some derivatives of the oxychlorides of silicon.—M. A. Boillot read a note on a new method of preparing ozone by means of carbon. The carbon is employed as the conducting film on the surface of the ozoniser. M. Gérardin presented a note on the amount of oxygen dissolved in rain water and in that of the Seine. Fine and persistent rain contains less oxygen than that of heavy and short showers.—Next came a note from M. Lortet on penetration of *leucocytes* into the interior of organic membranes.

DIARY

FRIDAY, JANUARY 3.

GEOLOGISTS' ASSOCIATION, at 8—On the Cambrian and Silurian Rocks of Ramsey Island, St. David's: Henry Hicks.—On the Diprionidæ of the Moffat Shale: Charles Lapworth.

SUNDAY, JANUARY 5.

SUNDAY LECTURE SOCIETY, at 4.—The next Transit of Venus, and the measurement of the distances of the Planets from the Sun: W. J. Lewis.

MONDAY, JANUARY 6.

LONDON INSTITUTION, at 4—On Air, Earth, Fire, and Water: Prof. Armstrong (Holiday Course, II.)
ENTOMOLOGICAL SOCIETY, at 7.
SOCIETY OF BRITISH ARCHITECTS, at 8.
MEDICAL SOCIETY, at 8.
VICTORIA INSTITUTE, at 8.

TUESDAY, JANUARY 7.

PATHOLOGICAL SOCIETY, at 8—Anniversary.
ANTHROPOLOGICAL INSTITUTE, at 8.—The Atlantean Race of Western Europe: The late J. W Jackson.—The Kojahs of Southern India: Dr. John Shortt—Primordial Inhabitants of Brazil: M. H. Gerber and Capt. Burton.
SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.
ZOOLOGICAL SOCIETY, at 8.30—Contributions to a general History of the Spongiadæ (Part IV): Dr. Bowerbank.—Report on a Collection of Sponges found at Ceylon, by E. W H. Holdsworth: Dr. Bowerbank.—On the Value in Classification of a peculiarity in the anterior margin of the Nasal Bones of some Birds: A. H. Garrod.
ROYAL INSTITUTION, at 3.—Juvenile Lectures—On Air and Gas: Prof. Odling.

WEDNESDAY, JANUARY 8.

GEOLOGICAL SOCIETY at 8.—On the Secondary Rocks of Scotland.—Part I. The Strata of the Eastern Coast: J. W. Judd.—Observations on the more remarkable Boulders of the North West of England and the Welsh Borders: D. Mackintosh.
GRAPHIC SOCIETY, at 8.
ROYAL SOCIETY OF LITERATURE, at 8.
ARCHÆOLOGICAL ASSOCIATION, at 8.

THURSDAY, JANUARY 9.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
ROYAL SOCIETY CLUB, at 6.
MATHEMATICAL SOCIETY, at 8.—On Parallel Surfaces: S. Roberts.—Summation of certain Series: Prof. Wolstenholme.
ROYAL INSTITUTION, at 3.—Juvenile Lectures—On Air and Gas: Prof. Odling.

BOOKS RECEIVED

ENGLISH.—Faith and Free Thought: S. Wilberforce (Hodder and Stoughton).—A Series of Botanical Labels for Herbaria: J. E. Robson (Hardwicke)—The Coal-Fields of Great Britain. 3rd edit.: E. Hull (Stanford).—Reprint of Papers on Electrostatics and Magnetism: Sir William Thomson (Macmillan & Co.).

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THURSDAY, JANUARY 9, 1873

DEEP SPRINGS

AS our contribution to a controversy which has now been going on for some weeks in the *Times*, and to which much public attention has been given, we have received Prof. Geikie's permission to print a Lesson from his forthcoming Primer of Physical Geography dealing with the subject of Deep Springs.

The facts which Prof. Geikie here summarises in so admirable a manner, taken in connection with what has already appeared in NATURE as to what one may almost call the cosmical connections of the recent rainfall, and the actual conditions of the case placed before the readers of the *Times* by Mr. Bailey Denton, should, we think, be enough to convince all that there is a science in these matters, and that the way in which Nature is in the habit of working should be at least understood, if even in only a feeble way, before a protest be entered against her.

Do we wish to continue to avail ourselves of surface springs? If so it must be remembered, first, that these are impossible without the deep springs of which Prof. Geikie speaks; secondly, that it may be roughly said, that they are normally replenished once a year, and that in some parts of England there has not been rain enough this year yet to replenish them. In the words of Mr. Denton:—

"During the summer months, from May to October, the rain which falls seldom reaches the depth of a yard. This has been clearly shown by Dickinson's records. During that period evaporation, exceeding the rainfall very considerably, draws upon the subterranean supply of water stored in the soil, and in continued drought the draught is immense. In the winter months, from October to May, when the rainfall exceeds the evaporation, the excess penetrates the earth, and having saturated the subsoil as it passes through it, the surplus descends to the springs or subterranean level to replenish the one and raise the other. To produce this super-saturation requires time, and hence it is that 'mid-winter'—*i.e.* the shortest day—is reached before the deep springs and deep water-beds are augmented."

The present controversy will do lasting good if it induces, and we think it may, accurate observations of the amount of water in the deep springs in different areas in different years, and at different times of the year. It is more than possible that the late heavy rainfall is even, from the deep spring point of view, a manifestation of a higher law—or of a miracle as Mr. Babbage would have called it—that nature may not only replenish our underground cisterns every year, but vary the yearly supply, over a period of eleven years or so.

Professor Geikie's "Lesson" runs as follows:—

"In this lesson we are to follow the course of that part of the rain which sinks below ground. A little attention to the soils and rocks which form the surface of a country is enough to show that they differ greatly from each other in hardness, and in texture or grain. Some are quite loose and porous, others are tough and close-grained. They consequently differ much in the quantity of water they allow to pass through them. A bed of sand, for example, is pervious, that is, will let water sink through it readily, because the little grains of sand lie loosely together, touching each other only at some points, so as to leave empty spaces between. The water readily finds its way among these empty spaces. In fact, the sand-bed may become a kind of sponge, quite saturated with the water which has filtered down from the surface. A bed of clay, on the other hand, is impervious; it is made up of very small particles fitting closely to each other, and therefore offering resistance to the passage of water. Wherever such a bed occurs, it hinders the free passage of the water, which, unable to sink through it from above on the way down, or from below on the way up to the surface again, is kept in by the clay, and forced to find another line of escape.

"Sandy or gravelly soils are dry because the rain at once sinks through them; clay soils are wet because they retain the water, and prevent it from freely descending into the earth.

"When water from rain or melted snow sinks below the surface into the soil, or into rock, it does not remain at rest there. If you were to dig a deep hole in the ground you would soon find that the water which lies between the particles would begin to trickle out of the sides of your excavation, and gather into a pool in the bottom. If you baled the water out it would still keep oozing from the sides, and the pool would ere long be filled again. This would show you that the underground water will readily flow into any open channel which it can reach.

"Now the rocks beneath us, besides being in many cases porous in their texture, such as sandstone, are all more or less traversed with cracks—sometimes mere lines, like those of a cracked window-pane, but sometimes wide and open clefts and tunnels. These numerous channels serve as passages for the underground water. Hence, although a rock may be so hard and close-grained that water does not soak through it at all, yet if that rock is plentifully supplied with these cracks, it may allow a large quantity of water to pass through. Limestone, for example, is a very hard rock, through the grains of which water can make but little way; yet it is so full of cracks or 'joints,' as they are called, and these joints are often so wide, that they give passage to a great deal of water.

"In hilly districts, where the surface of the ground has not been brought under the plough, you will notice that many places are marshy and wet, even when the weather has long been dry. The soil everywhere around has perhaps been baked quite hard by the sun; but these places remain still wet in spite of the heat. Whence do they get their water? Plainly not directly from the air; for in that case the rest of the ground would also be damp. They get it not from above, but from below. It is oozing out of the ground; and it is this constant outcome of water from below which keeps the ground wet and marshy. In other places you will observe that the water does not merely soak through the ground, but gives rise to a little runnel of clear water. If you follow such a runnel up to its source, you will see that it comes gushing out of the ground as a Spring.

"Springs are the natural outlets for the underground water. But you ask why should this water have any outlets, and what makes it rise to the surface?

"The subjoined figure (Fig. 1) represents the way in which many rocks lie with regard to each other, and in which you would meet with them if you were to cut a long deep trench or section beneath the surface. They are arranged, as you see, in flat layers or beds. Let us suppose that *a* is a flat layer of some impervious rock, like clay, and *b* another layer of a porous material, like sand. The rain which falls on the surface of the ground, and sinks through the upper bed, will be arrested by the lower one, and made either to gather there, or find its escape along the surface of that lower bed. If a hollow or valley should have its bottom below the level of the line along which the water flows, springs will gush out along the sides of the valley, as shown at *s s* in the woodcut. The line of escape may be either, as in this case, the junction between two different kinds of rock, or some of the numerous joints already referred to. Whatever it be, the water cannot help flowing onward and downward, as long as there is any passage by which it can find its way; and the rocks underneath are so full of cracks that it has no difficulty in doing so.

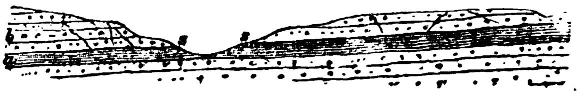

FIG. 1.—Origin of Surface Springs.

"But it must happen that a great deal of the underground water descends far below the level of the valleys, and even below the level of the sea. And yet, though it should descend for several miles, it comes at last to the surface again. To realise clearly how this takes place, let us follow a particular drop of water from the time when it sinks into the earth as rain to the time when, after a long journeying up and down in the bowels of the earth, it once more reaches the surface. It soaks through the soil together with other drops, and joins some feeble trickle, or some more ample flow of water, which works its way through crevices and tunnels of the rocks. It sinks in this way to perhaps a depth of several thousand feet until it reaches some rock through which it cannot readily make further way. All this while it has been followed by other drops, coursing after it through its winding passage down to the same barrier at the bottom. The union of all these drops forms an accumulation of water, which is continually pressed by what is descending from the surface. Unable to work its way downward, the pent-up water must try to find escape in some other direction. By the pressure from above it is driven through other cracks and passages, winding up and down until at last it comes to the surface again. It breaks out there as a gushing spring (see Physics Primer, Art. 23).

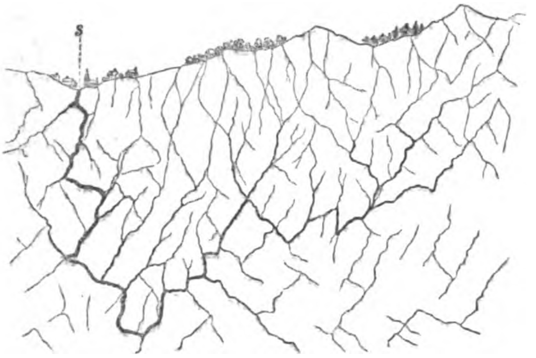

FIG. 2.—Section of part of a district to show the origin of deep-seated Springs. The Numerous joints in the rocks lead the water down into a main channel, by which it re-ascends to the surface as a spring at *s*.

"Thus each of the numerous springs which issue out of the ground is a proof that there is a circulation of water underneath, as well as upon the surface of the land. But besides these natural outlets, other proofs are afforded by the artificial openings made in the earth. Holes, called Wells, are actually dug to catch this water. Mines, pits, quarries, and deep excavations of any kind, are usually troubled with it, and need to be kept dry by having it pumped out."

It is a satisfaction to think that, as Science gets more infused into our general education, such a question as the one to which attention is now directed will not be mooted until its scientific bearings are understood; for after all the question of deep springs is only one of the scientific points involved in the controversy.

SHELLEY'S BIRDS OF EGYPT

A Handbook to the Birds of Egypt. By G. E. Shelley, F.G.S., F.Z.S., &c. 1 vol. 8vo, with 14 coloured plates. (London: Van Voorst, 1872.)

MANY travellers who go "up the Nile" during the winter months, devote the leisure, which would otherwise hang somewhat heavily on their hands, to making a collection of birds. The boating trip usual on these occasions is, as Captain Shelley observes, admirably adapted for this purpose, "as there is much time left on hand while the vessel is delayed by adverse winds; and even at other times progress is frequently not so rapid as to prevent the traveller from keeping pace with the boat, if he chooses to land for the sake of sport, which may generally be obtained on the banks of the river."

To such persons Captain Shelley's volume will be most acceptable, as there was previously no single work that contained sufficient information to enable them to determine the names of the birds met with on the Nile. Rüppell's "Systematische Uebersicht" gives a complete list of all the species known to occur in Egypt at the time of its publication. But besides being now rather out of date, Rüppell's volume does not include descriptions of most of the common birds, and requires to be supplemented by several other works hardly adapted for a traveller's library. Captain Shelley's handy volume contains a sufficiently full account of all the Egyptian birds hitherto recorded, and is therefore far more convenient for use during a tour up the Nile, though other works will be required on the return home, to enable some of the more closely allied species to be certainly discriminated.

As limits of the "Egyptian district," of which he treats, Captain Shelley takes the Mediterranean on the north, and the second Nile cataract on the south, with the Arabian and Libyan deserts to the east and west. Within this area about 350 species of birds are met with, of each of which a short description is given, together with remarks upon the time of its occurrence, habits, and other peculiarities. The greater number of the birds of Egypt are well-known European forms, but there is a considerable admixture of Oriental and African species. In the latter category we may notice the beautiful little sun-bird, *Nectarinia metallica*, of which the portrait forms the frontispiece to the volume. Captain Shelley met with it near Kalabshee in Nubia, where it is tolerably plentiful in April, but has "no doubt that it occasionally descends below the first cataract," as he noticed several specimens within twenty miles of Philæ. Other tropical forms which intrude into the Nile district are the yellow-vented Bulbul (*Pycnonotus arsinoe*), the Egyptian Bush-babbler (*Crateropus acaciæ*), the Bifasicated Lark (*Certhilanda desertorum*), and two other species of Bee-eater, besides the *Merops apiaster* which visits Europe. The most abundant groups among the Passerine birds of Egypt are, perhaps the Larks and the Stonechats, of both of which numerous forms occur along the Nile banks. Nearly all the European *Sylviidæ* are likewise found in Egypt, either all the year round, or in winter during their southern migration. The list of birds of prey is also numerous, and many of the eagles and hawks are said to be individually very abundant. In fact, Egypt must be pronounced to be quite a paradise for an ornithologist who wishes to "take it easy," and to collect a number of rare and interesting species without going far from home, or endangering his health in the forests of the tropics.

Whilst allowing Captain Shelley great credit for the general way in which he has performed his task, we must be permitted to point out several "heresies" in his scientific arrangement, which, however, are manifestly owing rather to carelessness than to ignorance. The Andalusian Hempode (*Turnix sylvatica*) certainly cannot be correctly referred to the Tetraonidæ—though Captain Shelley might find precedents for such a course—nor the Ibises, Storks, and Cranes to the Charadriidæ, for which, on the other hand, no sort of precedent will be found. It is also new to us to see the Rails and Crakes arranged in the order "Anseres" in the same family (!) as the Ducks and Geese, and the Gulls and Terns united to the Pelicans. Here, we suspect, our author must have got into some muddle in "making up his sheets." On the other hand, great praise must be awarded to the illustrations, which are obviously from the facile pencil of Mr. Keulemans, and represent some of the most novel and attractive species. We could only have wished that a map had been added, with all the localities spoken of by the author marked on it. In these days no work referring to geographical zoology can be deemed complete without a map to it.

OUR BOOK SHELF

A Manual of Chemistry, Theoretical and Practical. By George Fownes, F.R.S. Eleventh edition, revised and corrected by Henry Watts, B.A., F.R.S. (London: J. and A. Churchill, 1873.)

We have received the eleventh edition of Fowne's Manual of Chemistry. The great popularity of this famous chemical text-book has already necessitated the publication of this edition, although the last was only issued in 1868. Since that time great progress has been made in the science, and we must thank Mr. Watts for having made this edition fully equal to the present educational requirements of chemistry. In order to prevent the increase of the present volume beyond the slightly unwieldy size attained by the last, the editor has somewhat shortened the sections of the work relating to physics. This is by no means to be regretted, as admirable manuals on this subject are now within the reach of all.

Another improvement has been effected by the introduction of a chapter giving the most important points of the received theories of chemical combination and the atomic hypothesis. By thus giving the student some idea of the theoretical portions of the science at an early period, it becomes possible to make him acquainted with the use of formulæ much sooner than would have been the case had the original plan of the author been adhered to. A chromolithograph of various spectra forms the frontispiece, but we regret to find that the chapter on spectrum analysis is somewhat more meagre than might have been expected. We notice that the size of the page and of the type has been increased, and the whole appearance of the book improved, but the old woodcuts still do duty; this is a great pity, the French and German manuals very far surpass any of ours in this respect. Why should this be so? There can be no doubt that well executed sketches of apparatus are of great use to students in showing them how to do their work with neatness, and to none is this more important than to the large class of students now rising, who have to study the science without ever having the chance of seeing a well appointed laboratory or a good manipulator. R. J. F.

Elements of Zoology. By A. Wilson. (Edinburgh: Adam and Charles Black.)

Very high authorities have lately come to the conclusion—and the character of this book and of others like it lately published in Edinburgh confirm that conclusion—that it is not desirable to teach the *elements* of zoology at all. You cannot in a volume of 600 pages, illustrated with 150 woodcuts, really give an adequate account of the animal kingdom. Nothing less extensive than "Cuvier's Regne Animal," or "Bronn's Thierreich" can deal with the subject. The very essence of Zoology lies in a wide survey of forms which cannot possibly be illustrated in a cheap book. A museum, dissecting rooms, microscopes, special monographs, are necessary for the study of Zoology, and it is useless to give a hurried account of the larger groups into which animals are divisible as an introduction to it. We do not want such elements of Zoology taught in schools and junior classes—elements of which the teacher himself has probably no real knowledge from the study of nature—elements which it is clear that Mr. Wilson has put together from his notes of Prof. Allman's course, and from Prof. Huxley's publications—but which he knows but little of from his own observation of nature. What can be taught in place of such elements of Zoology is the ground-work of Biology; and this teaching designed to give a correct appreciation of the phenomena of life—not an exhaustive survey of all the forms and peculiarities of animal life—is a much more practicable thing for educational purposes and extra-university classes. Special types of both animal and vegetable life) are taken, which the teacher has himself studied, and which he can place in quantity in the hands of his pupils for like study. Real scientific training is thus promoted, and books which shall help this form of teaching are needed. On the other hand, books like Mr. Wilson's do a great deal of harm. They put zoology altogether out of the category of natural sciences, making it a subject of hearsay, and when written by men who are not themselves actively working zoologists, are simply mechanical epitomes or analyses of other men's work. Moreover, Mr. Wilson does not appear to possess qualifications for writing such an epitome, for he is not acquainted with French and German work.

Not to enter into the specific inaccuracies of this book, we may simply mention that it is not up to the times. It is ten or fifteen years behind its day throughout, the reason of which is obvious when we find that it is an abridgment of works published about fifteen years since. Fifteen years means a great deal in Zoology, the most actively advancing of any science at the present time, since Darwin's theory has stimulated research in it in all directions. There is no recognition in this book of Darwinism, no proper account of the Protozoa; development throughout is inadequately sketched, or in most cases altogether ignored. Geographical distribution might never have been studied during these twenty years.

We cannot view without great dissatisfaction the production of educational books like the present one on a branch of science in which the author has not worked himself, and in the progress of which he is not sufficiently interested to lead him to keep up with some of its most important advances. It is an injury to the study itself, and an injustice to those seriously engaged in that study.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Dr. Bastian's Experiments on the Beginnings of Life

In every experimental science it is of great importance that the methods by which leading facts can be best demonstrated, should be as clearly defined and as widely known as possible. This is particularly true as regards physiology, a science of which the experimental basis is as yet imperfect. All experiments by which a certainty can be shown to exist where there was before a doubt, serve as foundation stones. It is well worth while taking some pains to lay them properly.

Your readers are aware that Dr. Bastian, in his work on the Beginnings of Life, has asserted that in certain infusions the "lower organisms" come into existence under conditions which have been generally admitted to exclude the possibility of the pre-existence of living germs. It is also well known that these experimental results are disputed.

Not long ago I witnessed the opening of a number of experimental flasks charged many months ago by a friend of mine with infusions supposed to be similar to those recommended by Dr. Bastian. The flasks had been boiled and closed hermetically according to Dr. Bastian's method. Finding on careful microscopical examination that the contents of the flasks contained no living organisms, I charged calcined tubes with the liquids, sealed them hermetically, and forwarded them to Dr. Bastian. When I next saw him he pointed out that two of the three liquids used were not those which he had recommended, that if the infusions had been properly prepared, there would not have been any necessity for keeping them many months before examination, that his results with organic infusions were obtained after a few days, and that they were generally of a most unmistakeable nature. To satisfy my doubts on the subject he most kindly offered to repeat his experiments relating to the production of living organisms in infusions of hay and turnip in my presence. To this proposal (although I have hitherto taken no part in the controversy relating to spontaneous generation, and do not intend to take any) I gladly acceded, at the same time engaging to publish the results without delay.

Fifteen experiments were made. They were in three series, the dates of which were respectively, Dec. 14, Dec. 20, and Dec. 27.

FIRST SERIES—(Dec. 14th.)

Two infusions were employed, an infusion of turnip, in making which both the rind and the central part were used, and an infusion of hay. Both had been prepared the same day a short time before they were used.

The turnip infusion, of which the specific gravity was 1012, and the reaction distinctly acid, was divided into two parts, of which one was neutralised with liquor potassæ. Four retorts, each capable of holding, when half full, a little over an ounce of liquid, having been prepared, two were charged with neutral infusion, the other two with unneutralised infusion. A small quantity of pounded cheese was then added to one of each pair. A fifth retort was charged with unneutralised infusion diluted with its bulk of water. As soon as each retort was charged, the open end of its beak was heated in the blowpipe flame and drawn out. The drawn-out part was then severed, and the retort boiled over a Bunsen's burner, after which it was kept in a state of active ebullition for five minutes. During the boiling, some of the liquid was frequently ejected from the almost capillary orifice of the retort. At the end of the period named it was closed by the blowpipe flame, care being taken to continue the ebullition to the last. The success of the operation was ascertained in each instance by observing that, by wetting the upper part of the retort, the ebullition was renewed.

Three similar retorts were charged with the hay infusion, the specific gravity of which was 1005, and the reaction neutral. Of these, one contained the infusion diluted with its bulk of distilled water, the others being charged with infusion to which no addition had been made. These three retorts were closed, after boiling, in exactly the same way as those containing turnip infusion. The eight retorts were placed, immediately after their preparation, in a water-bath, which was kept at a temperature of about 30° C.

We met to examine the flasks on December 17, just three days after their preparation, Dr. Bastian having previously expressed his anticipation that the infusions of turnip with cheese, whether neutralised or not, would be found by that time to contain multitudes of Bacteria, and that the other two undiluted turnip infusions would exhibit obvious changes. In the hay infusions, he expected that the process would not advance so rapidly; the diluted infusions, he thought, would remain permanently unaltered. The results in each case were as follows:—

(*a.*) *Neutral turnip infusion with cheese.*—On the 16th I observed that the liquid had become turbid; on the 17th the turbidity was very obvious. Before opening the retort it was ascertained that when the blow-pipe flame was directed against the tube the heated part was drawn inwards, and further, that when the retort was inclined with its bulb upwards, so as to allow the liquid to rush against the closed end, a characteristic water hammer sound was produced. On breaking the point, air rushed in with a tolerably loud sound; the liquid was crowded with moderately sized Bacteria, which exhibited active progressive movements. There were also Leptothrix filaments.

(*b.*) *Unneutralised turnip infusion with cheese.*—On the 17th, the retort having been tested in the same way as before with similar results, was opened. It contained no living forms.

(*c.*) *Neutral turnip infusion without cheese.*—On the 17th this liquid exhibited no marked change. It was finally examined on the 31st, and found to be still unaltered.

(*d.*) *Unneutralised turnip infusion without cheese.*—Up to December 31 no change had taken place in this infusion.

(*e.*) *Undiluted hay infusion.*—The infusion was slightly turbid on the 17th; on the 20th the turbidity was more marked, and before the flask was opened, the water-hammer sound and other evidence showed that it was entire. The liquid was found to be full of minute but very active Bacteria, and contained numerous colonies of spheroids undergoing transformation into Bacteria. There were also Leptothrix filaments.

(*f.*) *The same.*—This infusion was examined on the same day. It had become turbid at about the same time as the last infusion, though to a less extent. It was distinctly acid. A drop of this fluid contained few Bacteria as compared with *e.*

(*g.*) *Diluted hay infusion.*—On the 20th it was discovered that the retort was accidentally cracked. The liquid was swarming with Bacteria, and possessed an offensive smell. On account of the crack, Dr. Bastian regarded the experiment as futile.

(*h.*) *Diluted turnip infusion.*—This liquid remained unchanged.

SECOND SERIES—(Dec. 20th.)

The purpose of this series was to ascertain whether the irregularities of the results with the turnip infusions in the first series, as compared with Dr. Bastian's already recorded results, were due to the fact that the material used consisted partly of rind. Dr. Bastian thought that this might be the case, and accordingly another infusion was prepared in which no rind was employed. As before, the fresh acid infusion of turnip was divided into two parts, one of which was neutralised by liquor potassæ. Of four retorts, three were charged with unneutralised liquid, the fourth with neutral. Of the three, two were treated with cheese; to the third no addition was made. They were prepared in every respect as before. In each case the drawing-in of the glass in the blowpipe flame was again noticed before the neck of the retort was broken.

(*a.*) *Unneutralised infusion with cheese.*—This infusion showed opalescence, even after twenty-four hours. On the 23rd it had become decidedly turbid, and was opened. The liquid was fœtid, and its reaction acid. It swarmed with Bacteria.

(*b.*) *The same.*—The retort was opened on the 31st, its contents having shown a slight turbidity for several days previously. The liquid was slightly fœtid, and it contained characteristic Bacteria, which, however, were few in number.

(*c.*) *Neutral infusion without cheese.*—The retort was opened on Dec. 31, the fluid having been slightly turbid for several days. The liquid was acid, and slightly fœtid, but still retained the odour of turnip. A drop contained a few Bacteria, about 0·003 mm. in length, which exhibited oscillatory movements.

(*d.*) *Unneutralised infusion without cheese.*—The liquid contained a white mass which lay at the bottom, and was so tenacious that it could be drawn out into strings with needles. This consisted entirely of Bacteria and Leptothrix, embedded in a hyaline matrix. There were also Bacteria in the liquid.

THIRD SERIES—(Dec 27th.)

It appeared to me desirable to ascertain whether the condition of the internal surface of the glass vessels exercised any influence on the result. I therefore heated two retorts to 250° C., keeping them at that temperature for half an hour, and closed them while hot in the blow-pipe flame. These Dr. Bastian charged by breaking off their points under the surface of a neutral infusion of turnip with cheese, freshly prepared for the purpose, without employing any of the rind. The retorts were boiled and sealed in the same way as before, excepting that whereas one was boiled only five minutes the other was boiled ten minutes. The specific gravity of the infusion used was 1013. A third uncalcined retort was charged with some of the same infusion containing no cheese. This was also boiled for ten minutes.

I was out of town from the 28th to the 30th, and therefore did not examine the retorts until the 31st. Dr. Bastian informed me that on the 28th, twenty-one hours after preparation, the liquids in both the calcined retorts were distinctly turbid, the temperature of the water bath being 32° C.: and that sixty-six hours after preparation, whilst the turbidity was much more marked, each flask also contained what appeared to be a "pellicle," which had formed and sunk. At this period the fluid in the third flask had also become very decidedly turbid.

(*a.*) *Neutral turnip infusion with cheese in calcined retort, boiled ten minutes.*—The retort having been tested in the way previously described, was opened on the 31st. The liquid was very fœtid, had an acid reaction, and contained much scum. It was found to be full of Bacteria, whilst Leptothrix existed in abundance in portions of the scum, together with granules of various sizes which refracted light strongly.

(*b.*) *The same boiled five minutes.*—The state of the liquid was the same as that just described.

(*c.*) *Neutral infusion without cheese, boiled ten minutes—retort not calcined.*—In this liquid the rods and filaments were much less numerous. In other respects its characters were the same.

In each case before opening the retort it was again observed that a portion of its neck became drawn in when exposed to the blow-pipe flame.

As regards the results of the foregoing experiments, it is unnecessary for me to say anything as to their bearing on the question of heterogenesis. The subject has already been frequently discussed in your columns.

The accuracy of Dr. Bastian's statements of fact, with reference to the particular experiments now under consideration, has been publicly questioned. I myself doubted it, and expressed my doubts, if not publicly, at least in conversation. I am content to have established—at all events to my own satisfaction—that, by following Dr. Bastian's directions, infusions can be prepared which are not deprived, by an ebullition of from five to ten minutes, of the faculty of undergoing those chemical changes which are characterised by the presence of swarms of Bacteria, and that the development of these organisms can proceed with the greatest activity in hermetically-sealed glass vessels, from which almost the whole of the air has been expelled by boiling.

J. BURDON SANDERSON

University College, Jan. 1

The Recent Star-shower at Sea

IN case no other account should reach you of a meteoric shower witnessed by the officers and military passengers of H. M. troopship *Tamar* on the night of Wednesday, November 27, 1872, I send notes collected from several accounts.

The vessel was at the time about 7° south and 4° west of the Bermudas, in longitude 68° 50′ W., latitude 25° 30′ N. Between 8 and 10 P.M. by one witness, between 10 and 12 P.M. by another, that is, between 12h. and 16h. Greenwich mean time, there was a nearly uninterrupted succession of shooting stars—from all parts of the sky, says one, from about E.N.E. to W.S.W., says another. The gentleman who gives the earlier hour estimates their number as from 25 to 50 per minute; the gentleman who gives the later at about 3 in 2 minutes. They were not counted or accurately observed by any one, but this discrepancy perhaps justifies the belief that the thickest part of the stream was passed through by the earth at the earlier hour. Sunset would have been soon after 5; thus it was dark with no moon before the earliest hour named.

I cannot learn that they were seen in Bermuda; but the weather was cloudy.

J. H. L.

Bermuda, Dec. 17, 1872

Curious Auroral Phenomenon

ON the nights of the 4th and 5th of this month a curious phenomenon, presenting much resemblance to an aurora borealis, was noticed here.

It had the character of a faint, steady light, rather red than yellow, extending over the horizon, which here in that direction is bounded by the sea-line, from N.W. to N.N.E.; while underneath it, that is between it and the horizon, was a rim of dark, smoke-like appearance, such as I have more than once seen in undoubted auroras. The smoky line occupied to a height of about three degrees above the horizon; the light to ten or twelve at most. On both nights it became visible about 9 P.M., and disappeared shortly after 11 P.M.

My house being situated rather more than 300 ft. above the sea and commanding a perfectly open view over it, I had a good opportunity of noticing this appearance: which was also observed and commented on by several other inhabitants of the town. On the night of the 6th I thought I could distinguish something of the kind, but the increasing light of the moon and a sea-fog coming on, rendered the fact uncertain.

The barometer was high, 30° 20″, the wind slight and from the east, the weather cool.

It may be worth adding that the water of the Black Sea being but slightly salt, its phosphorescent phenomena are proportionally insignificant. Hence I do not think that the light in question could have been any way reflected from the sea-surface.

No electrometer or instrument of the kind exists at Trebizond, but the uncomfortable sensations of which many people complained, and, I may add, the abundant sparks from my Tom's back—I ruffled it by way of trial on purpose—seemed to imply considerable electric tension in the atmosphere at the time. The weather was also remarkably dry.

Trebizond, Dec. 15, 1872 W. GIFFORD PALGRAVE

The Spectrum of the Aurora and of the Zodiacal Light

UPON a perusal of the chapter in Dr. Schellen's "Spectrum Analysis," specially bearing on the above subjects, I have been led to think—firstly, that our present knowledge of these spectra is far from complete; and secondly, that so far as such knowledge extends, it hardly warrants some of the conclusions arrived at in Dr. Schellen's work. To test the question of the aurora, I have collected, chiefly from the pages of NATURE, a set of observations (excluding a few which gave only rough results), and have arranged them under the heads of the several lines, so that these and their characteristics may be seen at a glance, and the observations compared; and from these observations I deduce the following remarks:—

1. That the full spectrum of the aurora consists of seven bright lines or bands and a faint diffused spectrum.

2. That two (perhaps three) of these lines are sharp and well defined, while the others are more or less nebulous. (As Lord Lindsay notes one of the lines to be sharp on one side and nebulous on the other, it is probable that this, and perhaps others of the nebulous lines, would resolve into groups of lines under higher instrumental power.)

3. That the red line (which seems to have been actually positioned by two observers only) is not found to coincide with the spectrum of any known substance or gas. (*But see next note.*)

4. That the yellow-green aurora line, and perhaps two other lines, according to one observer, coincide with lines of oxygen; while two lines, according to other observers, either fall very near to, or actually coincide with, F and G hydrogen, and that to this extent the axiom of Zöllner, that the spectrum of the aurora does not agree with any of the known spectra of the gases of our atmosphere, is challenged.

6. That Zöllner's theory of the lines or bands in the blue being remains of a continuous spectrum broken up by dark absorption bands, is hardly supported by the other observers.

7. That the aurora spectrum is probably a mixed one, and that the red and yellow-green lines are independent spectra; as also may possibly be the corona line and the continuous spectrum crossed with the fainter lines.

8. That the discrepancies in the observations recorded are considerable, and that all the lines (except, perhaps, Angström's), and specially the red one, require further examination to confirm their position.

And this last proposition I venture to commend to the attention of your spectroscopic correspondents during this winter.

The zodiacal light will also undeniably bear further investigation. The evidence at present seems to strongly incline to the presence of a faint continuous spectrum only. Webb, Backhouse, and Pringle are positive in their observations as to this; and, on the other hand, the bright green line referred to by Dr. Schellen, as seen by Angström and Zöllner *in all parts of the sky* can, as Pringle has well noticed, hardly be assumed to belong conclusively to the zodiacal light, but rather to some faint accompanying aurora. I am not aware whether the zodiacal light and the aurora have been examined with a polariscope. The light, though faint, might, I imagine, be tested with a Nicol's prism and Savart bands. An observation of the zodiacal light in the spring showed me its faint rose-red tint very distinctly, although I was not at that time aware that this tint was characteristic.

AURORA SPECTRUM

No. 1.—*A Line in the Red between C and D*

OBSERVER.	REMARKS.
T. F. (Torquay).	Strong, intermediate in colour and position to lithium and calcium.
J. R. C.	Like lithium line, but duskier; well seen in Browning's miniature spectroscope; sharp and well defined.
BARKER.	Almost equidistant between C and D; wave-length, 623* (C and D being respectively 656 and 589); sharp and well defined; brightness 3 (counting from 1 as brightest).
PROCTOR.	At 24; Ha being 18, and Na 32. Does not coincide with any other line observer has seen.
PIAZZI SMYTH.	Between sodium and lithium, but nearer the latter. Estimated at W.L. 6350.
BACKHOUSE.	Seen in eight auroras, out of thirty-four observed.
ZÖLLNER. (Schellen.)	More refrangible than Ha; possibly lies near the dark telluric lines A; wave-length, 6,279 (Angström).

No. 2.—*A Line in the Yellow Green between D and E (principal auroral line)*

T. F. (Torquay).	Strong; pale yellow near D.
J. R. C.	Sharp and well defined; like principal line in nebulæ, but brighter; a peculiar flickering noticed in the line during the displays of Oct. 1870 and Feb. 1872.
ALVAN CLARK, JUN.	Wave-length, 569. (Probably an error for 559.—J. R. C.)
BARKER.	Wave-length, 562; sharp and well defined; brightness, 1.
PROCTOR.	At 41 (Na being 32); nebulous; absolutely coincident with a line in a lumière tube attributed to oxygen.
LORD LINDSAY.	Sharp and well defined; visible with very narrow slit.
HERSCHEL.	Within a few units of Kirchhoff's 1255; a peculiar flickering, and frequent changes of brightness.
PIAZZI SMYTH.	Over citron acetylene, at W.L. 5579.
SCHMIDT. (Schellen.)	Varied much in intensity.
ZÖLLNER. (Schellen.)	Brilliant in all parts of the aurora.

No. 3.—*A Line in the Green near E (corona line?)*

ALVAN CLARK, JUN.	At 532; assumed to be 531·6 (corona line).
WINLOCK. (Schellen.)	Notes three lines in the aurora as coincident with corona lines.
LORD LINDSAY.	Near E.; woolly at the edges, but rather sharp in centre; at or near 1474 of the corona.
BACKHOUSE.	Once only, at 532.

No. 4.—*A Line in the Green at or near b*

ELGER.	Very faint; half way between principal auroral line and F.
BARKER.	At 517. (Assumed to be 520.—Winlock.) Nebulous; brightness, 5.
LORD LINDSAY.	A faint band coincident with *b*, and extending equally on both sides of it.
PROCTOR.	A faint band at 57, Na being 32 and Hβ 75, coincident with a line (of oxygen?) in lumière tube.

No. 5.—*A Line in the Green between b and F*

BARKER.	At 502; brightness, 2; conjectured to coincide with a line in the chromosphere.
BACKHOUSE.	Mentions a faint band seen in five auroras out of thirty-eight at 500 or 510 (501?—J. R. C.)

No. 6.—*A Line in the Green-Blue at or near F*

ELGER.	Faint and nebulous.
ALVAN CLARK, JUN.	At 485; assumed to be 486 F hydrogen.
BARKER.	At 482; assumed to be 485 of Alvan Clark, jun.
PROCTOR.	At 81; more refrangible than Hβ (75).
LORD LINDSAY.	Very slightly more refrangible than F; side towards D sharp and well defined; other side nebulous.

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* A line of nitrogen in the air spectrum seems to lie very close to this position, and if other lines lie so near to, or coincide with, those of oxygen and hydrogen, it would appear not unreasonable, until further evidence is obtained, to conjecture that the Aurora Spectrum may be wholly or in part an air spectrum modified by temperature pressure.—J. R. C.

No. 7.—*Line in the Indigo at or near G*

ALVAN CLARK, JUN.	At 435; assumed to be 434 G hydrogen.
PROCTOR.	At 121; *more* refrangible than $H\gamma$ (114); coincident with a line (of oxygen?) in lumière tube. Probably there is some error here; this line as positioned by Lord Lindsay and Alvan Clark, jun., being slightly *less* refrangible than G.—J. R. C.
LORD LINDSAY.	Slightly less refrangible than G; a broad, ill-defined band, seen only with a wide slit.

The continuous Spectrum

T. F. (Torquay).	Faint from about D to beyond F.
FLÖGEL. (Schellen).	Faint green reaching from aurora line to F.
SCHMIDT. (Schellen.)	From aurora line to F; frequently resolved into three bright lines.
ZÖLLNER. (Schellen.)	Considers the bright lines or bands Nos. 4, 6, and 7 to be a continuous spectrum broken up by dark absorption bands.

Guildford, Nov. 9 J. RAND CAPRON

Ocean Rainfall

WITH reference to Mr. Miller's note (NATURE, vol. vii. p. 123), I think it may be desirable to point out that a good many steps have been taken in the direction he suggests. As I believe Mr. Miller is a reader of "British Rainfall," he will probably hardly need to be reminded of the article on "Ocean Rainfall," by Mr. F. Gaster in the volume for 1866, wherein tables of the *prevalence* of rain in the North and South Atlantic and North Pacific Oceans are given in considerable detail. The determination of the amount is a far more difficult matter for a number of reasons, which would require much space fully to explain, and I am not at all surprised at the feat being considered "impossible;" but the use of that word is becoming restricted. At the British Association meeting at Brighton, Mr. W. T. Black was kind enough to show me a rain gauge which he had had constructed somewhat on the plan described by him in the *Journal of the Scottish Meteorological Society* for January 1870, and which he intended should make a few voyages on purpose to test.

With respect to gauges on lightships, I may state that at my suggestion the Elder Brethren of the Trinity House allowed a gauge to be placed upon the *Nore* lightship in the autumn of 1865. It was carefully observed by the officers on board for about two years, and the returns were compared with simultaneous records kept at Sheerness on the Kentish, and Shoeburyness on the Essex coast. I cannot say that I was satisfied with the results, which were principally vitiated by spray and wind. The gauge was bolted rigidly to a post on the deck of the vessel, as I then thought this preferable to the incessant oscillations which would result from the employment of gimbals

Considering the sources of inaccuracy attaching to the measurement of rainfall at sea, and the fact that, so far as I am aware, lightships are seldom more than ten or twenty miles from land, I think that there are few cases in which they could render valuable aid.

As to the *Challenger* I know nothing; but I do know that it was the joint resolution of Mr. Black and myself each and both to do what we could towards obtaining quantitative records of the rainfall of the North Atlantic, and when last I heard from him there were prospects of partial success. Only partial because we do not hope or expect to ascertain the true fall, but merely the relative fall in different zones, or portions of the ocean.

Camden Square, London G. J. SYMONS

INTRODUCTORY LECTURE OF THE MURCHISON CHAIR OF GEOLOGY AT EDINBURGH, SESSION 1872-3*

II.

MUCH has recently been said (so much, indeed, that the subject begins to get somewhat wearisome) regarding the necessity for wide-spread scientific instruction to enable our artisans to compete with the advancing industry of foreign countries. Technical education has become a kind of political cry, like the county franchise or women's electoral disabilities. We hear, continually, too, of the need for a more special training in science for such professional pursuits as those of the engineer and the military officer, or of the men who devote themselves to the task of geographical discovery. Far be it from me to say one word that would seem to imply an undervaluing of such practical applications of science. Most heartily do I wish that a technical school were established in every great town in the country, and that every man whose pursuits in life might call for the aid of science, should have the means of obtaining sound practical instruction in those branches likely to be of service to him.

But I cannot believe that such utilitarian views, important though they undoubtedly are, set before us the true place which science ought to hold, and which I am convinced it will one day hold in the general system of education in this country. Scientific culture is something more than a weapon to help us in the keen warfare of trade and commerce. It is, in truth, itself a noble form of education, filling a place which can be filled by none other, and without which no modern culture of the higher type can now rightly claim to be regarded as liberal.

It is this aspect of the subject which I seek to impress upon your minds to-day. I do so the more readily since it seems to me that your presence as members of this voluntary class is a token that you recognise with me the desirability of adding to the traditional methods of education. The matters which will come to be dealt with here lie outside of the ordinary curriculum of study. Yet they form part of that wider field which must ere long be conjoined with the older territories as the domain now to be required for higher culture.

Apart altogether from any practical application to be made of a scientific training for the active business of life, such a training seems to me to deserve and require a place in our ordinary system of education on several grounds, of which I shall at present notice only two—firstly, because it trains the observing faculty; and, secondly, because it stimulates the imaginative faculty.

I. Taking the lowest view of the case, it will not be denied that a habit of quick and accurate observation is one of the most advantageous powers with which a man or woman can be equipped. Such a habit often makes all the difference between a successful and an unsuccessful career. In point of actual hard-thinking power a man may be greatly superior to his fellows, but this power is not enough of itself alone to ensure success in the battle of life. Much must ever depend on the rapidity and shrewdness with which passing events are noted and provided for; or, in other words, the care with which the observing faculty is cultivated as well as the judgment.

But beyond and above such considerations we cannot doubt that the observing spirit carries about with it a multiplied power of enjoyment—so multiplied, indeed, that, placed beside the unobserving spirit, it seems almost to have been gifted with another sense. A well-trained power of observation never suffers its possessor to feel wholly alone. Even out of the most solitary scenes it can gather pleasant companionship, and amid the ordinary monotonous routine of life it finds recreation where, in its absence, men are apt to encounter only dulness. The story of our childhood—"Eyes and no Eyes"—has in this respect a significance for people of all ages as well as for schoolboys.

If you think of it you will probably find that what we ordinarily term *common sense* springs in no small measure out of this habit of observation. A man who is wont to keep his eyes open and take note of the changes continually going on around him, both among men and things, is more likely to acquire just views of the business of life than a man who takes notice only of what forces itself upon his attention.

From the moment of our birth we are surrounded by phenomena which demand our attention, and many of which will brook no neglect. We learn what heat is, not by the instruction of mother or nurse, but by the memorable experience of scalded tongue or burnt finger. The idea of distance grows upon us as our infant hands struggle in vain to grasp the picture on the farther wall, or to reach the moon. The notion of weight dawns upon our minds as the toy falls from our loosened grasp to the floor. In these and other ways Nature herself is our teacher; and we learn rapidly enough when not to do so involves us in continual physical suffering.

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* Continued from p. 165.

In our journey through life thousands of objects impress themselves on our mere outward eyes, yet are never really observed by us. Nay, they may actually in some degree reach the inner eye, and yet from want of training, or ignorance, or carelessness, we may never see these things as they essentially are, or as they would be seen by one whose observing faculty had been duly cultivated.

Some years ago I had an amusing illustration of this familiar fact in the case of a cottager in Ayrshire who stopped me on the high-road near his own door, late one autumn evening, to show me a will-o'-the-wisp. Never having had the good fortune to encounter one of these legendary sprites, I was naturally curious to see and hear about this example. I was told that it appeared in damp breezy weather in autumn and spring, usually in the evening, and never anywhere else than over the rubbish heaps of a deserted coal-mine. The light seemed, indeed, to my rather sceptical eyes strangely like the flicker of cottage windows seen behind some waving trees; but my informant assured me that he had watched the thing for fully thirty years, and could not be mistaken. Leaving him at his cottage, I made straight across a succession of fields and fences, and soon reached, in the fading twilight, the mound at the old coal-mine. There, however, I sought in vain for will-o'-the-wisp; but about a quarter of a mile farther on, on the other side of a strip of wood, now visible, now concealed, as the leaves happened to be stirred by the wind, were the flickering lights of a row of cottages. My friend had noted the lights, had even correctly enough connected their flickering with breezy weather; but his observations had gone no further, and so for thirty years he was content with an hallucination which he could at any time have dispelled in five minutes.

Many men never get very much further in their questioning and experiment of the external world than that degree of child-like experience which enables them to keep themselves from bodily harm or to obtain the means of bodily enjoyment. If this habit of observation be not already born and active in them the usual discipline of modern education does little to engender or quicken it. They are left to learn the use of their eyes as they best may, or to pass through life without ever learning to use them at all. There is still no special training in the cultivation of the observing faculty—a training not to be taken or left at the expense of parent or scholar, but which shall be an essential and imperative part of education.

Nevertheless, though this great faculty is left to such scanty collateral influences as it may receive from the already-authorised lines of instruction, it is as certainly capable of cultivation and improvement as any other part of our mental organism—nay, upon its proper cultivation much of our welfare and of our highest pleasure depends. Surely it is not too much to demand that a faculty to which the present epoch of human history owes in especial measure its characteristics, shall be recognised as one of the parts of our nature to be sedulously cared for in the instruction of youth?

Among the reforms of the future one will assuredly be the supplying of this defect in our present system of education. And in no way can this be so advantageously done as by the practical teaching of some branch of natural science. We may not increase the army of scientific discoverers, and there is no need that we should; but we shall at all events equip each man and woman with better armour for the battle of life, adding vastly at the same time to their capacity for some of the purest pleasures which are obtainable in this world.

2. Whatever tends to stimulate the imaginative faculty, taking us out of the routine of daily life, and enabling us to realise times and conditions different from those in which we live, helps to raise us in the dignity of thinking beings. This faculty is well cultivated by some parts of the traditional system of education. Literature, notably history and poetry, afford endless materials for this purpose. These materials deal largely with questions having a more or less distinctly human interest. Nevertheless, though man is himself the proper study of mankind, his conceptions cannot fail to be enlarged when he is brought face to face with a whole world of phenomena lying outside of himself and his experience. Such enlargement it is one of the tasks of science to ensure.

You will find it sometimes gravely asserted to be "a deviation from the correct use of language and a confounding of things essentially distinct to say that a man of science stands in need of imagination as well as powers of reason." I hope that before long you will perceive the fallacy of such an assertion and recognise the necessity of imagination not in the man of science only, but in every one who would adequately master the aims and results of scientific thought. Imagination, that is, the power of shaping in our minds a distinct picture of what from many observations of facts we determine to be the plan of nature, either now or in the past, lies at the very bottom of all thorough scientific research. Without imagination to gather them all up into a luminous conception, the scattered observations of countless independent workers would lose half their meaning, and indeed would often never be made at all, for in many cases they are themselves the suggestion of imagination. To deny to Science the use of this faculty would be to clip her wings, to forbid her to soar into the highest heavens, and to condemn her to a mere ant-like industry upon this nether earth.

In adding to the present curriculum of a liberal education some training in scientific habits of mind and work, we should in no wise deaden or hamper the free use of the imaginative faculty. On the contrary, we should furnish it with the complement of that anthropomorphic or subjective method of viewing things which mere literary training is apt to produce We should enable it to take a freer, wider grasp of creation and of man's place therein.

[The speaker here illustrated his argument by an example drawn from the geology of the neighbourhood of Edinburgh.]

Now this is but an ordinary and simple example of the kind of mental processes through which geology requires us to pass. There seems little worthy of note on a group of moss-grown lichened stones on a bare hill-side; yet the observing faculty, once put on the alert, readily detects the singularity of these boulders, sets about its task of gathering all the information to be gleaned regarding them and of preparing a body of evidence to be weighed and decided upon by the judgment. And then arises the imaginative faculty with its power of reproducing the past. Under its sway woodland and cornfield seem to melt away before us, the hills are once more sealed in ice, and fleets of boulder-laden bergs come drifting over what are now the fertile plains of the Lothians.

While, therefore, in the work which lies before you here it will be your endeavour to add to your knowledge, do not lose an opportunity of cultivating at the same time these two faculties. So long as your knowledge is merely from books, so long as you are content with a kind of mere cramming, such an opportunity will be little likely to occur. It is when you turn your knowledge to account and seek for illustration or expansion of it by direct personal appeal to Nature that your powers of observation and imagination will have free play.

Fortunately we meet in a district rich in incentives to appeals of this kind. Every crag and dell around seems to beckon us to its side that it may set problems before us for solution. Part of the work of the winter will lie in availing ourselves of these opportunities. We shall make visits to the hills and quarries of the neighbourhood, and test the lessons of the lecture-room by actual seeing and handling of the rocks.

Thus, while we gain larger conceptions of the structure and history of the planet on which we dwell, we shall at the same time perform no unimportant part in that long education which, though it stands out more prominently in our earlier years, is not less surely the business of our lives.

THE RECENT STAR SHOWER

A CONSIDERABLE number of exact determinations of the place of the radiant-point of the shooting stars recorded during the recent meteoric shower have during the last few days continued to reach me, of which the accompanying general list and a rough outline map (Fig. 2) will, perhaps, best convey the general result at present arrived at regarding this important point in connection with the astronomical character of its appearance. That the stream of meteors, originating in the materials of Biela's comet, pursue, in a current of great length and thickness, nearly the same orbit as that of the comet round the sun, may be clearly concluded from the many observations of the meteor shower which have now been brought together. Among the most interesting of the descriptions relating to this subject is a report by Dr. Heis, of Münster, in Westphalia, of the observations made at that observatory between 8h. and 9h. P.M., and of others which he received from distant places, of the frequency of the meteors at that and at later periods of the night. The number seen by two observers at Munster, in fifty-three minutes, between 8h. and 9h. P.M., was 2,200 meteors, 400 of which appeared in the last interval but one of six minutes before 9 o'clock, or about forty-two per minute during the whole time. At the Göttingen Observatory 7,710 meteors were counted in three hours, giving nearly the same average of frequency during the greater portion of the shower. At Svanholmsminde, in the north of Jutland, Mr. S. Tromholdt recorded, with the assistance of two observers, 600 shooting stars in the first quarter of an hour after 9 o'clock, or about forty per minute, as observed at Munster. Allowing at the latter place thirty minutes, and in Jutland forty minutes, as their longitudes in time, east from Greenwich, the great abundance of the meteors here noted nearly coincides with the second principal maximum of the shower seen by Mr. Lowe and by Prof. Grant, at Glasgow, to have occurred at about, or shortly after, 8 o'clock. From the same time until 11h. 30m. P.M. (10h. 50m. Greenwich time), Mr. Tromholdt counted 1,660 meteors in two hours and a half, indicating a greatly decreased intensity of the shower; and, although clouds then prevented further observations, a perfectly clear sky enabled him to resume them at half-past 4 o'clock A.M. (3h. 50m. Greenwich time) on the morning of the 28th, when he found the display to have entirely ceased, only four shooting stars making their appearance during the hour between half-past 4 and half-past 5 o'clock, or about 4 o'clock, Greenwich time.

In NATURE, vol. vii. p. 86, the observations of Mr. W. Swan, at St. Andrews, show that the termination of the shower had actually arrived at an earlier hour on the morning of the 28th, since, the sky being quite clear at half-past 1 o'clock A.M., no shooting stars could then be seen. A writer on the appearance of the shower at Dublin informs me that his observations fully corroborated this result, for, on looking out at about 1 o'clock (Irish, or nearly half-past 1 o'clock Greenwich time), the number of meteors was found to have diminished to about one in two or three minutes, and during a quarter of an hour after about half-past 2 o'clock, Greenwich time, not a single shooting star appeared in sight, although there was then always sufficient clear sky to enable one observer to have an uninterrupted field of view of the constellations. Both the extent of the densest portion and the limits of the extreme boundary of the stream are excellently marked by these valuable observations. There appears without doubt to have been a period of nearly uniform maximum intensity, lasting from shortly after 6 to shortly before 8 o'clock P.M., in which one observer might, under the most favourable circumstances, count from fifty to a hundred meteors per minute, or on an average about one meteor per second. The duration of this period seems to have been about an hour and a half, its centre occurring at about, or very shortly after, 7 o'clock. For about two hours after it, the shower lessened so gradually as not to fall much below a quarter of its maximum intensity until nearly 10 o'clock, but from that time it continued to decline so rapidly that soon after midnight one observer scarcely counted so many as one meteor per minute, and by 2 o'clock A.M. it had entirely disappeared. Taking its gradual rise before 7 o'clock to have been similar to its rate of diminution afterwards, and the whole time of its visibility to have been divisible into periods of two hours each, of which the central one, of greatest intensity, occurred between 6 and 8 o'clock P.M., and three others, on either side of this, might be distinguished as copious, conspicuous, and hardly more than ordinary meteoric displays, it is easy to estimate, from the known inclination at which the earth's path crosses the axis of the stream, the thickness of the meteoric stratum which it traversed in each of these successive periods. The actual width or transverse thickness of each of these meteoric strata must have been about 50,000 miles, and that of their whole sum, consisting of seven such periods, was about 350,000 miles. The diameter of the visible nebulosity of Biela's comet, as it was observed in telescopes, was estimated at 40,000 miles, and the nearest approach of its orbit to that of the earth, in 1832, was computed to be about 17,000 miles, so that the thickness of the meteor stream which the earth passed through on Nov. 27 last, exceeds these calculated dimensions by very many times. That it was, however, not the tail, or envelope, of the comet through which the earth passed, but a stream of particles left behind the nucleus of the comet on its track, was pointed out by a Dutch observer, and writer on the astronomical features of the shower (Herr Van de Stadt), in the *Arnhemsche Courant*, referred to in NATURE, vol. vii. p. 86. He founds this on the consideration that if, as the most probable calculations by Mr. Hind of the comet's path at this return inform us, it passed its perihelion on or about Oct. 6 last, and therefore, through its node, and its nearest point of approach to the earth's orbit about Sept. 14 last, it must, at the time of the occurrence of the meteor shower, have advanced some 250,000,000 miles, or about a seventh part of the whole circumference of its orbit along its path, having already passed its perihelion, and proceeded nearly as far as the orbit of the planet Mars in its subsequent departure from the sun, and its distant approach towards the opposite part of its orbit from the earth.

Projecting all the meteor-tracks which were recorded from my point of view, at Newcastle-upon-Tyne, upon a plane perspective chart of the constellations, a very evident centre of divergence of the shower from a space round a spot in R.A. 20°, N. Decl. 40°, is very clearly shown by the backward prolongations of the tracks, about 60 per cent. of which pass within 4° or 5° of this place. Many of the tracks recorded were somewhat widely erratic, coming chiefly from a more northerly area, between this place and Perseus or Cassiopeia. An extension of the radiant region in that direction or possibly its definite position there would perhaps have been recognised by more numerous observations continued to a later period of the shower; but clouds completely covering the sky after 7 o'clock, made the determination of its place by the 54 meteor-paths recorded during the preceding hour only apply to its position between 6 and 7 o'clock. The tracks of 23 meteors mapped at York by Messrs. E. Grubb, S. P. Thomson, and T. H. Waller, between 6h. and 10h. 15m. P.M. were communicated to me by Mr. Waller, and those of 17 meteors noted during the same time at Birmingham, by Mr. W. H. Wood. The positions assigned to the radiant point by these observers are respectively at R.A. 25°, N. decl. 40°; and R.A. 29°, N. decl. 45°; and a circular space having a line joining these two points for its diameter, includes between 60 and 70 per cent. of the backward prolongations of the 40 meteor-paths thus traced upon the maps. I have also received from Mr. Backhouse a list of 50 meteor-tracks observed at Sunderland before 7h. and after 9 o'clock; and a sufficient number of recorded paths from the Rev. S. J. Perry, at Stonyhurst, to determine the radiant point exactly, on the night of the 27th as well as on that of December 4, when he observed some remarkable bright meteors proceeding

Fig. 1.

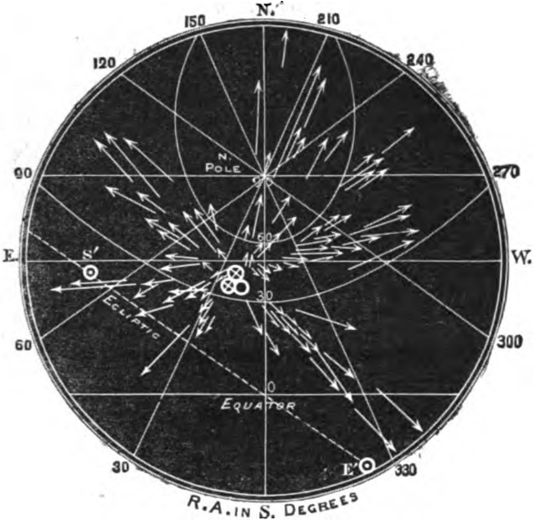

FIG. 1.—Tracks of 94 shooting stars observed at York, Birmingham, and Newcastle-on-Tyne, Nov. 27, 1872.

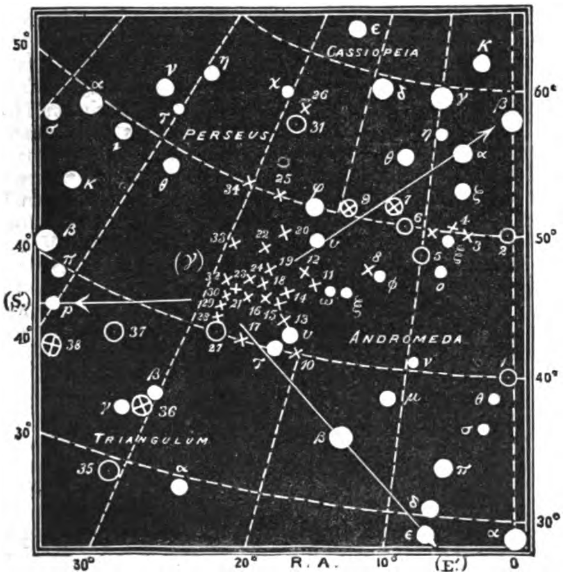

FIG. 2.—Map of the radiant points of the Meteor-shower, Nov. 27, 1872

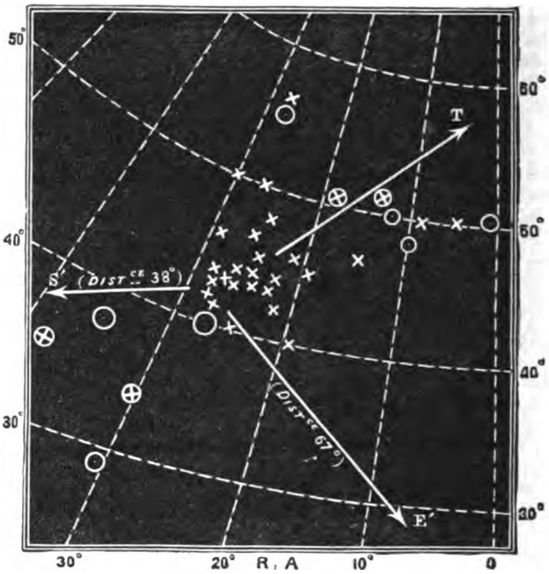

FIG. 3.—Map of radiant points, Nov. 27, 1872, and lines of direction to the points (S′) opposite to the sun's place, (E′) opposite to the earth's way, and (T) transverse to the last direction.

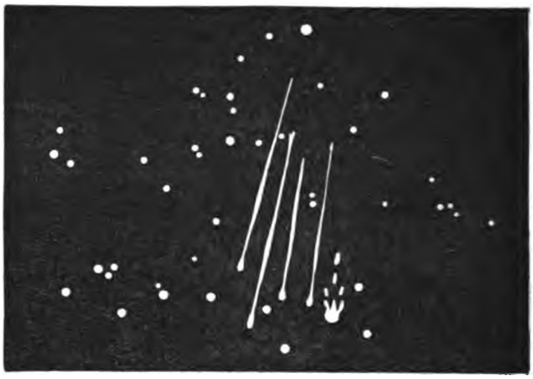

FIG. 4.—Large Meteor, at $5^h\ 50^m$ (the first observed), and paths of the next four meteors seen during the great meteor-shower of Nov. 27, 1872, $5^h\ 50^m\ 55^s$.—W. F. Denning (Bristol).

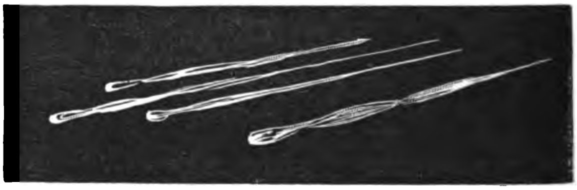

FIG. 5.—Flight of three collateral and contemporaneous meteors, with long parallel courses of 20° or 30°; and streak of a fourth meteor, showing its long endurance near the centre of the track. Seen during the great meteor-shower of Nov. 27, 1872.—S. H. Miller (Wisbeach).

from the same direction. It was remarked by Mr. Backhouse, and it must have been apparent to most attentive observers of the shower, that the meteors far from the radiant point did not always appear to move in parallel paths when in the same part of the sky; thus at once giving the idea that the radiant area was really of considerable extent. Although the contrary phenomenon of two or three bright meteors apparently running a race with each other in parallel courses side by side, or pursuing each other upon the same path, was frequently observed, and occasionally, as noticed by Mr. S. H. Miller at Wisbeach, who, as well as Mr. Denning at Bristol, supplied the accompanying sketch of such meteors through closely adjacent courses of 20° or 30°, yet it was perhaps in the often occurring exceptions to this rule, and in the absence of the long-enduring light streaks, left parallel to each other on such occasions by the Leonids, that the recent meteor shower differed most remarkably from its great precursors of the 13-14th November, 1866-7. In his suggestions to observers and conjectures on the probable early identification of this meteor-shower, published in the Transactions of the Vienna Academy of Sciences in 1868, it was remarked by Prof. Weiss, from the near approximation of the meteors in the direction of their motion to that of the earth in its passage through their stream, that the radiant region of this star-shower, even when witnessed at its greatest intensity, would probably prove to have a considerable area rather than to be concentrated, like the radiant point of the 13th of November meteors, from Leo, about a point of very accurate divergence of their tracks. From the situation of the comet's paths, and from its small velocity relatively to the earth, small deviations from parallelism in the original courses of the meteors would appear as considerably exaggerated inclinations of the visible meteor-paths to each other, and as somewhat more exaggerated ones (the original velocities of all the meteors being supposed the same)—in the proportion of about 10 to 7—when the deviation is transverse to, than when it is in the same plane as the direction of

APPARENT PLACES OF THE RADIANT-POINT OF THE STAR-SHOWER OF NOVEMBER 27, 1872

No.	Observer.	Place of Observation.	Local Lines of Observation.		Position of the Radiant Point by the Stars and Constellations.		
			From	To	R. A.	N.Decl	
			h. m.	h. m.			
1	Ph. Breton.	Grenoble (France).	7 0	8 0	(0	40°)	Between Cassiopeia and the square of Pegasus.
2	J. W. Durrad.	Leicester.			(0	50)	South-west of Cassiopeia.
3	W. H. Wood.	Birmingham.	6 0	10 15	5	50	Near ξ Cassiopeiæ (outlying radiant).
4	E. V. Pigott.	Malpas.	7 0		9	50	About ξ Cassiopeiæ.
5	Communicated by Mr. Denning.	France.			(10	48)	South of Cassiopeia.
6	Watkins Old.	Hereford.			(10	50)	A little south of Cassiopeia.
7	G. H. H.	Birkenhead.	5 30	10 0	12	50	South of μ Cassiopeiæ
8	J. J. Plummer.	Durham.	7 0		15	46·5	Close to φ Andromedæ.
9	H. Weightman.	Oundle.	5 30	7 35	18	51	Between θ Cassiopeiæ and 51 Andromedæ (υ Persei).
10	A. S. Herschel.	Newcastle-on-Tyne.	6 0	7 0	20	40	Near υ Andromedæ
11	W. H. Wood.	Birmingham.	6 0	10 15	20	45	Near ω ,,
12	J. Birmingham.	Tuam (Ireland).			21·7	45·5	Near χ ,,
13	Dr. J. G. Galle.	Breslau (Germany).	6 20	7 50	22	42	Near υ ,,
14	F. B. Knobel.	Burton-on-Trent.	5 35	6 50	22·5	44	Near χ ,,
15	M. de Gasparis.	Naples (Italy).	7 0	9 0	23	43	Near υ ,,
16	A. Marth.	Gateshead.	5 45	6 30	24·5	43	Near χ ,,
17	T. H. Waller.	York.	6 0	10 15	25	40	Near γ ,,
18	T. W. Backhouse.	Sunderland.	5 30	11 5	25	44	Near χ ,,
19	R. Grant and G. Forbes.	Glasgow.	5 35	10 30	25	45	Near χ ,,
20	W. Swan.	St. Andrews (Scotland).	8 20	11 30	25	48	Near φ ,,
21	T. P. Barkas.	Newcastle-on-Tyne.	5 45	6 45	26·2	43	Near χ ,,
22	E. J. Lowe.	Beeston (Notts).	5 50	10 30	26·2	46·2	Near γ ,,*
23	S. J. Perry.	Stonyhurst.	9 29		26·6	43·8	Near γ ,,
24	Mr. Fearnley.	Christiania (Norway).	8 25	9 3	27	43	Near γ ,,
25	Dr. E. Heis.	Münster (Westphalia).	8 0	9 0	27	50	Near φ Persei (54 Andromedæ).
26	J. J. Plummer.	Durham.	9 45		27	56	Near χ Persei
27	W. B. Shorto.	Suez (Egypt).			(28	41)	General centre between Aries, Perseus, and Cassiopeia.
28	G. Lespiault.	Bordeaux (France).	5 0	9 30	28	44	Near γ Andromedæ.
29	F. Denza.	Moncalieri (Piedmont).	6 0	12 0	28	41·7	γ Andromedæ.
30	A. D. P.	Newcastle-on-Tyne.	6 0	6 30	28	41·7	Close to, if not coincident with, Mirach (γ Andromedæ).
31	H. W. Hollis.	Newcastle (Staffordshire).	7 40	8 17	(28	55)	Between Perseus and Cassiopeia.
32	M. Glotin.	Bordeaux (France).	5 0	9 30	29	43	Near γ Andromedæ.
33	W. F. Denning.	Bristol.	5 50	6 30	29	46	Near γ ,,
34	M. Lernosy.	Macon (France).	7 0	13 0	30	50	Near υ, φ Persei (51, 54 Andromedæ).
35	A. Secchi.	Rome (Italy).	8 0		(31	29)	Between Aries, Triangulum, and Musca.
36	,,	,,	9 0		31	34	Near β, γ Trianguli.
37	,,	,,	12 0		(35	38)	Between Triangulum and head of Medusa.
38	W. Garnet.	Clitheroe.	7 50	8 35	40	35	A point on the verge between Triangulum and Perseus.

* The position at R.A. 2h. 45m., N. Decl. 46¼°, given in Mr. Lowe's description of the shower, in the *Times* of November 29, is apparently a misprint for 1h. 45m. (26¼°), which is here adopted as the R.A. of the Radiant-point near γ Andromedæ. close to which star Mr. Lowe describes the appearance of a stationary meteor at 8h. 52m., as bright as that star, among the many meteors which he observed, apparently without motion about the radiant-point.

the earth's motion through the stream. In the former direction (which is 30° or 32° nearer to a meridian than the direction of the sun's apparent place) the exaggeration of the apparent meteor observations is about 2½ times, and in the latter direction only about 1¾ times the original observations of the meteor-paths from perfect parallelism in their cometary orbits. Differences of velocity of the individual meteors from the average velocity of the stream, amounting to a tenth part of their mean speed, would on the other hand produce observations of 5° in the latter, without producing any sensible enlargement of the space included by the radiant region in the former direction. Owing to the powerful action of disturbing forces in changing both the direction and the velocities of motion of the meteors of this stream, a considerable extension of the radiant region in each direction from the mean radiant centre, might be certainly anticipated for this meteor shower. The combined causes affecting the form of the radiant area, its principal concentration along a straight or crooked line, or elongated space, and its motion with the time, are accordingly so considerable and various, that the problem of arriving at a true theory of their action must evidently be regarded as still continuing to invite further attention and research. Among the determinations of the position of the radiant point with which I have, however, become acquainted since the compilation of the present list, Prof. Newton's observations on the radiant region, which appeared in NATURE, vol. vii. p. 122, will perhaps appear, from the following considerations, to point to a somewhat more definite conclusion.

In the accompanying projection (Fig. 1) the apparent paths of the 94 meteors mapped at Newcastle-on-Tyne, York, and Birmingham are drawn on a plane-perspective chart of the heavens in their observed lengths and positions. Both their general divergence from a common centre and the irregularities of their divergence in many cases in distant parts of the sky are plainly seen, while the shortness of the paths near the radiant point clearly illustrates the effect of perspective in foreshortening the apparent courses of those meteors whose visible paths were represented, as they appeared to the observers, to be approaching them "end on." Some few of the foreshortened meteors appeared quite stationary, and two of these are represented in the drawing by a small star. Nearly round the places of these two stationary meteors are drawn small circles representing the positions of the radiant point observed at York and Birmingham; a third small circle shows the place of that observed at Newcastle-on-Tyne. They are numbered respectively 17, 11, and 10 in the list, and in the map of radiant points (Fig. 2). A small circle below the equator and another near the east point of the plain sphere upon the ecliptic (Fig. 1) represent respectively the anti-apex (or point *from which* the earth was moving), and the anti-solar point, or point *opposite to* the sun's place at the time of the star-shower. The latter point, it will be seen, is more nearly in the direction of a parallel of declination through the radiant-point than in the direction of a meridian, and it is in the direction of right ascension, or nearly in that of the sun's apparent place at the time of the shower, that a considerable elongation of the radiant region is described as having been most plainly perceived by Prof. Newton.

In the map of the radiant-places (Fig. 2), lines drawn from the star γ Andromedæ (which is replaced in the figure by the positions of several radiant-points described close to it), through β and ε Andromedæ, downwards, and through the small star ρ Persei towards the left, point towards the anti-apex, and to the anti-solar point; while a third line drawn from the same star nearly through υ Persei and α Cassiopeiæ is in a direction transverse to that from the anti-apex. Those radiant-points of which the star places or co-ordinates are exactly given are represented in the map by a cross; where only described by their neighbourhood to certain stars the cross is surrounded by a circle, and when simply described by the constellations their positions are represented by a circle only.

A large number of radiant-points is contained in the space included between the stars γ, τ, υ, ω, and 51 Andromedæ (υ Persei) clustering closely about a small star (not shown in the map) χ Andromedæ, near the centre of the space, of which the position is very nearly that deduced from calculation, as the probable radiant-point of the cometary shower. The direction of the outlying radiant-places is chiefly towards Cassiopeia, and shows with some distinctness a general confirmation of the conclusion obtained from direct observations of the shower by Prof. Newton, that the area of the radiant region was perceptibly elongated in right ascension, or approximately in the direction of the sun's apparent place. That the effect of the sun's attraction on a cometary cloud would be to produce an elongation of the radiant area in that direction appears on astronomical grounds to be capable of demonstration; and in their sensible agreement with this condition the results of the present observations lend satisfactory support to the astronomical theory of the meteor stream. A more complete analysis of the features presented by the radiant area would probably require a careful investigation of the disturbances which the meteor cloud may have undergone during many previous revolutions of the comet; but from the present comparison of the observations with the astronomical theory of comets and of meteor showers, there appears at least to be abundant evidence in their generally accordant results to show that beyond the regular action of universal gravitation, no powerful force of repulsion from the sun, like that supposed to be concerned in the enormous development of the tails of comets, affects the meteor orbits or changes their courses more than the regularly recurring revolutions of the planets. In the projection (Fig. 3) the radiant-points only and the directions of the three lines drawn from γ Andromedæ towards the antisolar point S′, the anti-apex of the earth's way E′, and towards a point T, at right angles to the latter direction, are represented for greater clearness without the fixed stars or constellations.

In my last letter in NATURE, vol. vii. p. 103, on the time of the maximum and the duration of the star-shower, and on meteors connected with it seen on adjacent nights, the remarkably bright meteors from the same radiant-point observed by Mr. Jackson on the evening of November 24, were noted by him near Hyde Park, and not near Regent's Park, as stated in my letter. A considerable shower of shooting stars from a radiant-point near γ Andromedæ was, it appears, distinctly observed on the same night in the United States, as described by Prof. Newton in NATURE, vol. vii. p. 122. The notes of the numbers of meteors seen after 10 o'clock, described in the last paragraph of my former letter were made by my assistants and myself at Newcastle-on-Tyne, and not at Rothbury, as would appear from their connection with the description immediately preceding them, by my correspondent on the very brilliant appearance of the shower near the latter place.

A. S. HERSCHEL

NOTES

WE believe that a reply has been received from the Government on the subject of the Arctic Expedition, which goes far to justify all that was said in our leader last week on the subject; for although the Government does not refuse absolutely to comply with the wishes of the deputation, all action will, unless strenuous efforts are made, be postponed for a year. We repeat that the deputation did not represent Science so broadly as it ought to have been represented; and we add, that if the Government thought so, it was, in our opinion, perfectly justified in refusing the demands made upon the national purse. To a certain extent, what happened in the case of the Eclipse Expedition of 1870 has been now repeated. Our readers will recollect that on that occasion the mere personal application of the Astronomer Royal was at once very properly refused, while a proper representation by the leading Societies was at once as promptly acceded to.

WE beg to draw our readers' attention to a new medical journal which commenced its career yesterday, the *Medical Record*, and which, judging from the prospectus and the contents of the first number, is likely to be of the very highest service to the important department with which it is connected, and to the sciences on which that department depends. The *Medical Record* is a weekly review of the progress of medicine, surgery, obstetrics, and the allied sciences, but does not seek to trench on the ground already occupied by other medical journals. The object of this weekly periodical will be to supply medical readers with a condensed, readable, and reliable analysis of the immense mass of information relating to the medical sciences now scattered over the surface of British and Foreign periodical medical literature. The number, the bulk, the cost, and the diffusion of the transactions and periodicals at home and abroad, in which this information is contained, are now so great as to place it beyond the reach of the most industrious. The annual transactions of the great societies of Europe and America alone occupy some scores of volumes, therefore the idea is a happy one of gathering the cream of these transactions and presenting it in an accessible and manageable form, before the transactions are out of date, to those who otherwise might never get a glimpse of them. Moreover, as the prospectus says with truth, the age of year-books has passed away, and to make the labours of scientific inquirers in the medical as well as in other departments intelligible and of practical use, they must be studied and appropriated when first announced. To enable this to be done for medicine is the object of the *Medical Record*, and we have every reason to believe it will be eminently successful in attaining its end. The new journal will be edited by Mr. Ernest Hart. The abstracts will be signed in all cases. The staff includes upwards of forty of the best known scientific members of the profession, most of them hospital teachers in London, Edinburgh, and Dublin.

SIR WILLIAM JENNER has been elected President of the Pathological Society, London.

THE Lectureship on Botany of the St. Thomas's Hospital Medical School is vacant through the resignation of the Rev. J. W. Hicks. Applications should be sent to the Medical Secretary on or before January 10.

A NEW society has been organised in Sacramento, California, under the name of "The Agassiz Institute." It has been formed on the model of the Essex Institute, Salem, Massachusetts, and owes its birth in great part to the recent visit of Prof. Agassiz in California.

A NEW work on the Cetaceans and other Marine Animals of California, is announced by Captain Scammon. It will be published by subscription through the Naturalist's Agency, Salem, Massachusetts, U.S.A.

THE planet (128) which we noted last week as having been discovered by M. A. Barrelly on the night of December 4—5, is the same as that discovered by Prof. Watson, Ann Arbor Observatory, on the night of Nov. 25, noted in NATURE of December 19 last.

THE association proposed for the promotion of explorations in Africa by the Berlin Geographical Society has constituted itself under the title of the African Society, its principal members being Drs. Schweinfurth, Rohlfs, Bastian, Peschel, Bruhns, and Petermann.

THE *Challenger* left Lisbon yesterday.

THE United States Coast Survey party, in charge of W. H. Dall, arrived in San Francisco on the 20th of September, on the *Humboldt*, after an absence of thirteen months. This time had been chiefly spent in the region between Kadiah and Oonalaska, among the Aleutian Islands. Among the more important results of the work are the determination of ten islands and rocks, fourteen harbours and anchorages (and many minor details) not on any chart; the determination of a great oceanic current, a reflected branch of the great North Pacific easterly stream, which sweeps to the south and west, south of the peninsula of Alaska and the islands, having a breadth of about 350 miles; and the discovery of new fishing banks off the southern end of Kadiah. Geological and zoological researches were carried on by the members of the party during that portion of their time when hydrographic work was impracticable; and though these investigations were entirely subsidiary to the regular work, they were crowned with unexpected success, especially in the departments of botany and geology, and the various groups of marine vertebrates. These collections, although still but superficially examined, indicate a curious resemblance in some particulars between the fauna of the region visited and that of the Straits of Magellan, a number of forms found being common to both, and not yet discovered in the intervening regions.

THE American papers talk with just pride of the great engineering feat which is now nearly completed at the expense of the Massachusetts Treasury, and which will shorten the railway distance between Boston and Troy and Albany, by 40 miles. A tunnel 4·66 miles through the Hoosac mountains has been in progress since 1855, but was not seriously entered on till 1863. The cutting was made from both ends, and so nice were the calculations of the engineers, that when on December 12th last, the two boring parties met, the two cuttings were found to vary not more than a foot either in grade or in line.

SIR BARTLE FRERE and his suite left Aden on board the *Enchantress* for Zanzibar last Saturday.

IN reference to the Cambridge Natural Science Tripos a correspondent informs us that the new scheme of examination has been carried out for the first time in this Tripos. It is as follows:—The examination occupies eight days, six in one week and two in the next, the first three of which are devoted to six papers, intended to test a general elementary knowledge of all the subjects. Two days are then occupied by practical examinations in chemistry, anatomy, and physiology; and in the last three, six papers are set, each containing several questions relating to the higher branches of each subject; and a candidate may not be placed in the first class unless he show a competent knowledge of botany, chemistry, geology, mineralogy, or physics, or of any two of the following,—Anatomy, Physiology, or Zoology; the intention being that a student should confine his high reading to one, or at most two subjects.

THE third series of meetings of the Cambridge Natural Science Club, established in March 1872, by some of the junior members of the University, was held during the last October Term; a paper was read at each meeting by the member in whose rooms the Club met, and the attendance of members and of visitors was usually good, though as the examination for the Natural Sciences Tripos approached, it fell off slightly. The following is a list of the papers, which were illustrated as far as possible with drawings, specimens, or experiments:—The Theory of Pangenesis, by Mr. F. M. Balfour (Trinity); Geological Faults, by Mr. R. D. Roberts, B.Sc. (Clare); Some Bone-caves in Herefordshire, by Mr. J. J. H. Teall (St. John's); The Rock-fragment of the Cambridge Upper Greensand, by Mr. A. J. Jukes-Browne (St. John's); The recent Deep-sea Dredging Expeditions, by Mr. P. H. Carpenter (Trinity); The derived Fossils of the

Cambridge Upper Greensand, by Mr. A. F. Buxton (Trinity); The Mechanism of Consciousness and Volition, by Mr. H. N. Martin, D.Sc. (Christ's).

MR. G. F. RODWELL lectures at the London Institution on Wednesday, 15th inst., on "Ancient Science."

THE Sunday Lecture Society has issued a very satisfactory programme for the next three months. On Jan. 26, Mr. A. H. Green gives a lecture "On the Glacial Period; a Chapter of English Geology." On Feb. 23, Mr. A. Balmanno Squire lectures on "The Skin; its Structure and Uses." Last Sunday Mr. W. J. Lewis lectured on "The Next Transit of Venus, and the Measurement of the Distances of the Planets from the Sun."

THE Mercers' Company have given notice that during the ensuing Hilary Term the lectures founded by Sir Thomas Gresham will be read to the public gratuitously in the theatre of Gresham College, Basinghall Street. Among them are lectures on Astronomy by the Rev. Joseph Pullen, on the 11th, 13th, and 14th inst.; Physic, by Dr. Symes Thompson, on the 17th and 18th; Geometry, by the Dean of Manchester, on the 25th and 27th.

A FUND is being raised for founding, at University College London, an Exhibition in commemoration of the services of the late W. A. Case, M.A. The Exhibition is to be held by students on leaving the college school, with which Mr. Case was connected for twenty years. The amount already promised is upwards of 300*l.*

THE Professor of Mineralogy (Mr. Miller) at Cambridge, will lecture on Mineralogy on Mondays, Tuesdays, Wednesdays Fridays, and Saturdays, from 1 to 2, in the lecture-room at the north end of the west wing of the new museum, commencing January 31.

Two very interesting birds have just been received by the London Zoological Society, an American Stilt or Stilt-plover (*Himantopus nigricollis*), and a Darter (*Plotus anhinga*), both of them remarkable in form and appearance, and new to the Society's collection. They are to be seen in the Fish-house.

THE first number of the new monthly journal of popular antiquities, *Long Ago*, is a capital one, the contents being very varied and of wide range. If it keeps up as it has begun, it will be of real and lasting value.

A NEW series of the *Mechanics' Magazine* is to be commenced this month, under the new and admirably brief title of *Iron.*

WE would draw the attention of our readers to a series of letters on the marriage of the Emperor of China which have been appearing in the *Daily News*, especially to the one in Tuesday's issue describing the structure of "the Temple of Heaven" and other temples, in which certain astronomical notions seem to be involved, suggesting comparison with certain theories about the pyramids of Egypt.

WE are glad to see, from some scraps sent us from the New York papers, under the title of "News Splinters," that Prof. Tyndall is making excellent use of Mr. W. Spottiswoode's polariscope apparatus. So impressive and popular apparently are his lectures on polarisation, that one of the "splinters" remarks that "if anybody don't go who can get a ticket to go to hear this very remarkable course of lectures, he or she deserves rectilinear propagation into outer darkness." We believe that Prof. Tyndall is expected back on the 25th or 26th inst.

WE are glad to see, in the *Mercantile Marine Magazine*, an article on "Meteorology: Past, Present, and Future, General and Particular." It would, however, have been better had the writer had the courtesy to acknowledge that his article was suggested by, and is largely based upon, an article in NATURE for December 12 last, on the "Meteorology of the Future."

WE learn from the *British Medical Journal*, that there is some prospect that a long-talked of scheme—the removal of the Medical School of St. Andrew's University to Dundee—may be carried out. A large field for medical instruction is to be obtained in connection with the Dundee Royal Infirmary; and a similar step, that of the University of Durham, which established a Medical School in Newcastle, has not been without success.

THE following is from the *Medical Record*:—"The recent meeting at Bordeaux of the French Association for the Promotion of Science, in its first annual session, appears to have sown seed which is likely to ripen in good fruit in that city. At a preliminary meeting held on Dec. 20, a committee was named, consisting of well-known physiologists, chemists, and men of science and others, to carry out a proposed scheme of general regulations for a laboratory of physiological and chemical research. Important sums were offered for the purpose, and the muncipality of Bordeaux, appreciating the importance of encouraging scientific labours, will, it is stated, contribute handsomely to the installation and maintenance of the proposed laboratory."

THE feuilleton of the *Gazette Medicale* for January 4 contains a number of details concerning English medical education, medical fees and etiquette.

THE number of *L'Institut* for January next commences a new series. This Journal has been in existence for forty years.

STANLEY'S "How I found Livingstone," is being translated in *Le Tour du Monde.*

THERE is a very good article in the *Field* for January 4, exposing some popular delusions with regard to the dangers incurred by living in or travelling through countries where snakes are abundant. The writer thinks it would be difficult to produce a well-authenticated instance of a European having been killed by a snake in any tropical country. Many of these delusions the writer ascribes to the sensation stories found in some popular novels, *e.g.* "Tom Cringle's Log," and some of Marryatt's works, as also in the narratives of credulous travellers, and even in the works of such an eminent ornithologist as Audubon. "The actual risk incurred," the writer says, "by those who visit and explore the haunts of snakes is practically so inconsiderable as very soon to become habitually as much disregarded as is the existence of the common adder in this country." He also animadverts with justice on the extreme vagueness of the multitude of popular names applied to snakes, and speaks of the necessity of always recognising the established system of technical nomenclature, without which all is vague and delusory.

WE have received a lecture delivered before the Torquay Natural History Society by its Vice-president, the Rev. T. R. R. Stebbing, M.A., on "Museums and *Our* Museum," in which he gives some very excellent hints as to what a model museum, both general and local, ought to be. This society has been in existence for twenty-eight years, and during that time has done much useful scientific work, and accumulated a valuable collection of specimens illustrating the natural history of the country, which already exceeds the accommodation at the society's disposal. Its reference library is also rapidly increasing in bulk, and the society has therefore appealed to the Torquay public to assist in raising such a building as will satisfy the requirements of the lectures, library, and museum. Not only for the sake of the society, but for the sake of their own highest good, we hope the public of Torquay will respond liberally to the society's appeal.

THE SCIENTIFIC ORDERS OF THE "CHALLENGER"

I.

WE have received from the Admiralty permission to publish the following Report of the Circumnavigation Committee of the Royal Society, on the work which lies before the *Challenger* Expedition. We are sure its perusal will gratify all our readers.

The principal object of the proposed expedition is understood to be to investigate the physical and biological conditions of the great ocean-basins; and it is recommended for that purpose to pass down the coast of Portugal and Spain, to cross the Atlantic from Madeira to the West Indian Islands, to go to Bermuda, thence to the Azores, the Cape de Verde Islands, the coast of South America, and across the South Atlantic to the Cape of Good Hope. Thence by the Marion Islands, the Crozets, and Kerguelen Land, to Australia and New Zealand, going southwards *en route*, opposite the centre of the Indian Ocean, as near as may be with convenience and safety to the southern ice-barrier. From New Zealand through the Coral Sea and Torres Straits, westward between Lombok and Bali, and thence through the Celebes and Sulu Seas to Manilla, then eastward into the Pacific, visiting New Guinea, New Britain, the Solomon Islands; and afterwards to Japan, where some considerable time might be profitably spent. From Japan the course should be directed across the Pacific to Vancouver Island, then southerly through the eastern trough of the Pacific, and homewards round Cape Horn. This route will give an opportunity of examining many of the principal ocean phenomena, including the Gulf-stream and equatorial currents; some of the biological conditions of the sea of the Antilles; the fauna of the deep water of the South Atlantic, which is as yet unknown, and the specially interesting fauna of the borders of the Antarctic Sea. Special attention should be paid to the botany and zoology of the Marion Islands, the Crozets, Kerguelen Land, and any new groups of islands which may possibly be met with in the region to the south-east of the Cape of Good Hope. Probably investigations in these latitudes may be difficult; it must be remembered, however, that the marine fauna of these regions is nearly unknown, that it must bear a most interesting relation to the fauna of high northern latitudes, that the region is inaccessible except under such circumstances as the present, and that every addition to our knowledge of it will be of value. For the same reasons the expedition should, if possible, touch at the Auckland, Campbell, and especially the Macquarie Islands. Particular attention should be paid to the zoology of the sea between New Zealand, Sydney, New Caledonia, and the Fiji and Friendly Islands, as it is probable that the Antarctic fauna may be found there at accessible depths. New Britain and New Ireland are almost unknown, and from their geographical position a special interest attaches to their zoology, botany, and ethnology. The route through this part of the Pacific will give an opportunity of checking and repeating previous observations on the structure of coral reefs and the growth of coral, and of collecting series of volcanic rocks. The Japan current will also be studied, and the current along the coast of California. The course from Japan to Vancouver Island and thence to Valparaiso will afford an opportunity of determining the physical geography and the distribution of life in these regions, of which at present nothing is known.

I.—*Physical Observations*

In crossing the great ocean basins observations should be made at stations the positions of which are carefully determined, chosen so far as possible at equal distances, the length of the intervals being of course dependent on circumstances. At each station should be noted the time of the different observations, the state of the weather, the temperature of the surface of the sea, the depth, the bottom temperature determined by the mean of two Miller-Casella thermometers, the specific gravity of the surface- and bottom-waters. The nature of the bottom should be determined by the use of a sounding-instrument constructed to bring up samples of the bottom, and also, if possible, by a haul of the dredge. When practicable, the amount and nature of the gases contained in the water, and the amount and nature of the salts and organic matter should be ascertained. As frequently as possible, especially in the path of currents, serial temperature-soundings ought to be taken either with the instrument of Mr. Siemens, or with the Miller-Casella thermometer, and in the latter case at intervals of 10, 50, or 100 fathoms, to determine the depth and volume of masses of moving water derived from different sources.

The simple determination of the depth of the ocean at tolerably regular distances throughout the entire voyage is an object of such primary importance that it should be carried out whenever possible, even when circumstances may not admit of dredging, or of anything beyond sounding. The investigation of various problems relating to the past history of the globe, its geography at different geological epochs, and the existing distribution of animals and plants, as well as the nature and causes of oceanic circulation, will be greatly aided by a more accurate knowledge of the contour of the ocean-bed.

Surface-Temperature.—The surface-temperature of the sea, as also the temperature of the air as determined by the dry- and wet-bulb thermometers, should be regularly recorded every two hours during the day and night throughout the voyage.

These records should be reduced to curves for the purpose of ready comparison; and the following points should be carefully attended to:—

1. In case of a general correspondence between the temperature of the sea and that of the air, it should be noted whether in the diurnal variation of both, the sea appears to *follow* the air, or the air the sea.

2. In case of a marked discordance, the condition or conditions of that discordance should be sought in (*a*) the direction and force of the wind, (*b*) the direction and rate of movement of the ocean surface-water, (*c*) the hygrometric state of the atmosphere. When the air is very dry, there is reason to believe that the temperature of the surface of the sea is reduced by excessive evaporation, and that it may be below that of the subsurface stratum a few fathoms deep. It will be desirable, therefore, that every opportunity should be taken of comparing the temperature at the surface with the temperature of the subsurface stratum—say at every 5 fathoms down to 20 fathoms.

Temperature-Soundings.—The determination of the temperature, not merely of the bottom of the ocean over a wide geographical range, but of its various intermediate strata, is one of the most important objects of the expedition; and should, therefore, be systematically prosecuted on a method which should secure comparable results. The following suggestions, based on the experience already obtained in the North Atlantic, are made for the sake of indicating the manner in which time and labour may be economised in making serial soundings, in case of the employment of the Miller-Casella thermometer. They will be specially applicable to the area in which the work of the expedition will commence; but the thermal conditions of other areas may prove so different, that the method may need considerable modification.

The following strata appear to be definitely distinguishable in the North Atlantic:—(*a*), a "superficial stratum," of which the temperature varies with that of the atmosphere, and with the amount of Insolation it receives. The thickness of this stratum does not seem to be generally much above 100 fathoms, and the greatest amount of heating shows itself in the uppermost 50 fathoms. (*b*) Beneath this is an "upper stratum," the temperature of which slowly diminishes as the depth increases down to several hundred fathoms; the temperature of this stratum, in high latitudes, is considerably *above* the normal of the latitude; but in the intertropical region it seems to be considerably *below* the normal. (*c*) Below this is a stratum in which the rate of diminution of temperature with increasing depth is rapid, often amounting to 10° or more in 200 fathoms. (*d*) The whole of the deeper part of the North Atlantic, below 1,000 fathoms, is believed to be occupied by water not many degrees above 32°. With regard to this "glacial stratum," it is exceedingly important that its depth and temperature should be carefully determined.

It will probably be found sufficient in the first instance to take, with each deep *bottom* sounding, *serial* soundings at every 250 fathoms, down to 1,250 fathoms; and then to fill up the intervals in as much detail as may seem desirable. Thus where the fall is very small between one 250 and the next, or between any one and the bottom, no intermediate observation will be needed; but where an abrupt difference of several degrees shows itself, it should be ascertained by intermediate observations whether this difference is sudden or gradual.

The instrument devised by Mr. Siemens for the determination of submarine temperatures is peculiarly adapted for serial measurements, as it does not require to be hauled up for each reading. It should, however, be used in conjunction with the Miller-Casella thermometer, so as to ascertain how far the two instruments are comparable; and this point having been settled, Mr. Siemens's instrument should be used in all serial soundings; and frequent readings should be taken with it, both in descending and ascending.

A question raised by the observations of the U.S. Coast Surveyors in the Florida Channel, and by those of our own surveyors in the China Sea, is the extent to which the colder and therefore heavier water may run *up hill* on the sides of declivities. The position of the Azores will probably be found very suitable for observations of this kind. Temperature-soundings should be taken at various depths, especially on their north and south slopes, and in the channels between the Islands; and the temperatures at various depths should be compared with those of corresponding depths in the open ocean.

It is in the southern oceans that the study of ocean-temperatures at different depths is expected to afford the most important results; and it should there be systematically prosecuted. The great ice-barrier should be approached as nearly as may be deemed suitable, in a meridian nearly corresponding to the centre of one of the three great southern oceans;—say to the south of Kerguelen's Land; and a line of soundings should be carried north and south as nearly as may be.

In connection with the limitation of the area and depth of the reef-building corals, it will be very important to ascertain the rate of reduction of temperature from the surface downwards in the region of their greatest activity; as it has been suggested that the limitation of living reef-builders to 20 fathoms may be a thermal one.

Wherever any anomaly of temperature presents itself, the condition of such anomaly should, if possible, be ascertained. Thus there is reason to believe that the cause of the temperature of the surface-water being below that of the sub-surface stratum, in the neighbourhood of melting ice, is that the water cooled by the ice, by admixture with the water derived from its liquefaction, is also rendered less salt, and therefore floats upon the warmer and salter water beneath. Here the determination of Specific Gravities will afford the clue. In other instances a warm *current* may be found beneath a colder stratum; and the use of the "current-drag" might show its direction and rate. In other cases, again, it may happen that a warm submarine spring is discharging itself,—as is known to occur near the island of Ascension. In such a case, it would be desirable to trace it as nearly as may be to its source, and to ascertain its composition.

Movements of the Ocean.—The determination of *Surface-*Currents will, of course, be a part of the regular routine, but it is particularly desirable that accurate observations should be made along the line of sounding in the Southern Ocean, as to the existence of what has been described as a general "Southerly set" of Oceanic water, the rate of which is probably very slow. It is also very important that endeavours should be made to test by the "current-drag," whether any *underflow* can be shown to exist from either Polar basin towards the Equatorial region. A suitable locality for such experiments in the North Atlantic would probably be the neighbourhood of the Azores, which are in the line of the glacial flow from the North Polar Channel. The guide to the depth at which the current-drag should be suspended, will be furnished by the thermometer, especially where there is any abrupt transition between one stratum and another. It would be desirable that not only the rate and direction of surface-drift, but those of the subsurface-stratum at (say) 200 fathoms' depth, should be determined at the same time with those of the deep stratum.

Tidal Observations.—No opportunity of making tidal observations should be lost. Careful observations made by aid of a properly placed tide-pole in any part of the world will be valuable. Accurate measurements of the sea-level once every hour (best every *lunar* hour, *i.e.* at intervals of 1^h 2^m of solar time) for a lunar fortnight (the time of course being kept) would be very valuable information.

Bench-marks.—In reference to the interesting question of the elevation or subsidence of land, it will be very desirable, when sufficient tidal observations can be obtained to settle the mean level of the sea, that permanent bench-marks should be established, recording the date and height above such mean level. Even recording the height to which the tide rose on a certain day and time, would render a comparison possible in future years.

A good determination of the mean sea-level by the simple operation of taking means may be made, in less than two days, with even a moderate number of observations *properly distributed so as to subdivide both solar and lunar days into not less than three equal parts.* Suppose, for example, we choose 8-hour intervals, both solar and lunar. Take a lunar day at 24^h 48^m solar time, which is near enough, and is convenient for division; and choosing any convenient hour for commencement, let the height of the water be observed at the following times, reckoned from the commencement:—

h	m.	h.	m.	h	m.
0	0	8	0	16	0
8	16	16	16	24	16
16	32	24	32	32	32

The observations may be regarded as forming three groups of three each, the members of each group being separated by 8 hours solar or lunar, while one group is separated from the next by 8 hours lunar or solar. In the mean of the nine results the lunar and solar semi-diurnal and diurnal inequalities are all four eliminated.

Nine is the smallest number of observations which can form a complete series. If the solar day be divided into m and the lunar into n equal parts, where m and n must both be greater than 2, there will be mn observations in the series; and if either m or n be a multiple of 3, or of a larger number, the whole series may be divided into two or more series having no observation in common, and each complete in itself. The accuracy of the method can thus be tested, by comparing the means obtained from the separate sub-series of which the whole is made up.

Should the ship's stay not permit of the employment of the above method, a very fair determination may be made in less than a day, by taking the mean of n observations taken at intervals of the nth part of a lunar day, n being greater than 2. Thus if $n=3$, these observations require a total interval of time amounting to only 16^h 32^m. The theoretical error of this method is very small, and the result thus obtained is decidedly to be preferred to the mere mean of the heights at high and low water.

The mean level thus determined is subject to meteorological influences, and it would be desirable, should there be an opportunity, to redetermine it at the same place at a different time of year. Should a regular series of observations for a fortnight be instituted, it would be superfluous to make an independent determination of the mean sea-level by either of the above methods at the same time.

Besides taking observations on the ordinary waves of the sea when at all remarkable, the scientific staff should carefully note circumstances of any waves attributable to earthquakes.

Specific Gravity.—The Specific Gravity of the surface and bottom-water should be carefully compared, whenever soundings are taken; and whenever Serial Soundings are taken, the Specific Gravity at intermediate depths should be ascertained. Every determination of specific gravity should be made with careful attention to temperature; and the requisite correction should be applied from the best Table for its reduction to the uniform standard of 60°. It would be well to check the most important results by the balance; samples being preserved for examination in harbour. Wherever the temperature of the surface is high—especially, of course, in the intertropical region—samples should be collected at every 10 fathoms for the purpose of ascertaining whether any effect is produced upon the specific gravity of the upper stratum by evaporation, and how far down this effect extends.

Transparency of the Water.—Observations for transparency should be taken at various depths and under different conditions by means of Mr. Siemens's photographic apparatus. As, however, the action of this depends upon the more refrangible rays, and the absorption of these and of the more luminous rays might be different, and that in a manner varying with circumstances, such as the presence or absence of suspended matter, &c., the transparency of the sea should also be tested by lowering a white plate or large white tile to various measured depths, and noting the change of intensity and colour as it descends, and the depth at which it ceases to be visible. The state of the sky at the time should be mentioned, and the altitude of the sun, if shining, roughly measured, or if not shining, deduced from the time of day.

Relation of Barometric Pressure to Latitude.—In Poggendorff's "Annalen," vol. xxvi. 1832, p. 395, is a remarkable paper by Prof. G. F. Schouw on the relation between the height of the barometer at the level of sea, and the latitude of the place of observation. At page 434 is a rough statement of the results of his researches, the heights being given in Paris lines.

Lat. o	Barometer mercury at 0° C.
0	337·0
10	337·5
20	338·5
30	339·0
40	338·0
50	337·0
60	335·5
65	333·0
70	334·0
75	335·5

The expedition might contribute to the examination of this law, not only by giving special attention to the barometer observations at about the critical latitudes 0°, 30°, 65°, 70°, but also by comparing any barometers with which long series of observations have been made at any port they may touch at, with the ship's standard barometer.

It appears probable from Schouw's paper, that certain meridians are meridians of high pressure and others of low pressure.

For comparison of barometer and measures of heights, it appears that the aneroid barometer constructed by Goldschmid of Zurich, would be very useful.

It is very desirable that the state of the barometer and thermometer should be read at least every two hours.

(To be continued.)

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*TERRESTRIAL MAGNETISM**

II.

THE problem was attacked later on by General Sabine in a much more definite manner, and with much greater chance of success. The earth, as we are all well aware, moves round the sun in an elliptic orbit, the nearest approach of the two bodies occurring at about the time of the winter solstice; if, therefore, there be an annual inequality, it will probably attain its maximum when the earth is in perihelion, and its minimum at aphelion, since the magnetic force is known to vary inversely as the square of the distance. The year was, therefore, divided by Sabine into two equal parts, and the mean of all the observations taken during the six winter months compared with the mean for the six summer months. The records of the three British observatories of Hobarton, Toronto, and Kew all agree in showing that the magnetic intensity of the earth is greater in winter than in summer. This was very satisfactory; but the same calculations have since been made for other magnetic stations, where monthly determinations of the three elements are carried on without interruption, and some of the results are far from confirming the above conclusion; for we find that observatories as near as Kew and Greenwich are in direct opposition on this point. A more extensive series of comparisons will finally show how far this disagreement depends on the accidental nature of the observing stations; but at present the preponderance of the evidence is decidedly in favour of a semi-annual inequality.

A similar investigation of the effect of the moon's action on terrestrial magnetism requires a series of observations made at much less distant intervals than the monthly ones, which suffice for the study of the annual variation. This new question presents itself to our view under a twofold aspect. The effect of the moon may be studied either in its independent action, or as it acts conjointly with the sun; in the former case we must group the observations with respect merely to the position of the moon in its orbit, and, as this is an ellipse with the earth in the focus, the force, varying inversely as the square of the distance, will have its maximum disturbing influence at perigee and its minimum at apogee. The range also of the inequality will depend on the eccentricity of the orbit, and the period of variation will coincide with the siderial, or more strictly the anomalistic, month of a little over twenty-seven days.

But if we consider the moon as acted upon by the sun, receiving its magnetic power, as it does its light and heat, from the central body of our system, or merely having its own inherent magnetism modified by solar action, then we must choose as our unit the lunation, or synodic month of 29·5 days, observing the changes that take place as the moon approaches to or recedes from the sun. A careful sifting of the Greenwich observations led Mr. Airy to a belief in the existence of a menstrual inequality of the declination, attaining its maximum on the fifth day of the moon's age, and of a semi-menstrual inequality of the horizontal force whose maximum occurs on the second day. The solar effect on the moon's magnetic power would, therefore, appear to be cumulative, and not to be fully developed till several days subsequent to the conjunction of the two bodies.

No examination seems to have been as yet made to test the existence of a monthly variation due to the independent action of the moon, as the sole disturbing force.

The sun's rotation on his axis presents another not improbable cause of periodic magnetic disturbance. For if the sun acts as a large magnet directly upon the earth, and the poles of the sun's axis of rotation are not coincident with its magnetic poles, the rotation will present the solar magnetic poles alternately to the earth, and these acting singly, the result must be a synodic inequality, dependent on the period of the sun's rotation. The absence of any such irregularity is adduced, by a recent author on terrestrial magnetism, as a proof that the variations of the earth's magnetic force are due solely to the indirect action of the sun; but Prof. Hornstein has just succeeded in detecting in the magnetic records of Prague and Vienna an inequality in very close accord with the synodic period of the rotation of the solar spots. The magnetic period of 26 days 8 hours would give, as the true time of the sun's rotation, 24d. 13h. 12m., whereas Spörer, from the most accurate observations of spots near the sun's equator, found the time to be 24d. 12h. 59m. It becomes, therefore, probable that the sun has a direct magnetic action upon the earth, but this need not in the least interfere with the probability of its simultaneous indirect action by means of its thermal energy.

Having been able to detect, in the manner just described, the inequalities arising from the orbital motions of the earth and moon, we are immediately tempted to suppose that the diurnal rotation of the earth must also exert a not inconsiderable effect on the magnetism of any particular station on the earth's surface, and possibly even affect terrestrial magnetism as a whole. It is well known that change of temperature has a very powerful influence on magnetism, and therefore we should be astonished to find that the daily range of temperature induced no corresponding range in the earth's magnetic elements. The freely-suspended magnet is the most delicate of thermometers, and consequently, unless we wish the diurnal variation of the earth's magnetism to be completely veiled by the more extensive changes due to the varying heat of the magnet itself, we must take the greatest care to keep the suspended needle in a locality not directly affected by the daily alternations of temperature. Attending to this precaution, by building our magnetic chamber at a considerable depth below the surface of the ground, we still find that there exists a most decided daily range in the motion of the magnet, to which the most delicate thermometer is wholly insensible. This daily range was detected by Graham as early as 1724, and a momentary inspection of nearly any two days' march of the suspended needle will suffice to make this point evident. The maximum west declination, about 2 P.M., is constant throughout the year, whilst the principal minimum varies with the seasons, as do also the secondary maximum and minimum. Canton has accounted for the leading feature in this diurnal change by the fact that the solar heat lessens the magnetic power of that portion of the earth on which it directly falls, and thereby gives a preponderating influence to the opposite portion, whose strength remains undiminished; the needle, therefore, moves towards the West in the morning, and only returns towards the East as the Western sun restores the balance of attracting forces.

But there are other variations of the daily range besides those just mentioned, for not only do most of the inflections of the diurnal curves alter their time with the progress of the sun in his orbit, but the amplitude of the range passes through a constant order of phases as each year advances. Dr. Lloyd discovered that the maximum range of declination in summer is greater than in winter, and Quetelet not only confirms this, but also finds that the range is greater at the equinoxes than at the solstices. It was whilst engaged upon this investigation that the Director of the Brussels Observatory made the curious discovery, that the magnetic energy varies in the same manner as the vegetable force, both attaining their maximum in April, and diminishing gradually until they reach their minimum of intensity in the winter months. Other observers, such as Lamont of Munich, Col. Beaufoy, &c., may be cited in confirmation of the existence of this apparent connection between the vegetative force and that of magnetism, a connection which may perhaps serve to throw some light on the nature of magnetic action. The horizontal force follows a law similar to that of the declination, varying in its daily range with the seasons, and attaining its maximum value in summer.

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* Continued from p. 173.

Another peculiar semi-annual inequality in the diurnal variation has been detected by Mr. Chambers, the times of opposition being the equinoxes. This inequality is found to exist in the observations taken at seven stations—five in the northern, and two in the southern hemisphere. It only lasts from 6 A.M. to 6 P.M., reaching its maximum at 9 A.M. from January to June, and at 3 P.M. from July to December, always passing through the mean value at noon.

If now we turn from the consideration of the effect of the earth's rotation on the direct solar magnetism to examine its influence on that of our satellite, we are again led to expect a positive result, but on very different grounds from those we have just been reviewing. The heat sent to us by the moon, even when full, is so insignificant, that it is requisite to collect the rays in some enormous mirror, such as that of the Earl of Rosse, or to bring them to a focus on a very sensitive thermometer, in order to make it sensible. It would be absurd then to look for any effect that the rotation might produce in the variation of the temperature; but it is very reasonable to expect that the alteration of distance due to the rotation will not be equally insensible. We are not separated from our satellite by more than 240,000 miles, and as the diameter of the earth is nearly 8,000, the rotation may alter the distance of the moon from a station on the earth's surface by about one-thirtieth of the whole distance, and the resulting change of the attracting force must be very considerable. An examination of the Greenwich magnetic observations, arranged according to lunar hours, has led Mr. Airy to the conclusion that no doubt can be entertained as to the existence of a luno semi-diurnal inequality, though he has failed to detect any luno diurnal inequality. He also found so close an agreement between the values of the luno semi-diurnal variation in the years of greater and also of smaller solar curves, that he suggests the two following "conjectural reasons for this remarkable association in the time-law of changes of solar and lunar effect. One is that the moon's magnetic action is really produced by the sun's magnetic action; and a failure in the sun's magnetic power will make itself sensible, both in its direct effect on our magnets, and in its indirect effect through the intermediation of the moon's excited magnetism. The other is, that, assuming both actions, solar and lunar, to act on our magnets indirectly by exciting magnetic powers in the earth, which alone or principally are felt by the magnets, the earth itself may have gone through different stages of magnetic excitability, increasing or diminishing its competency to receive both the solar and lunar action." The ratio of the moon's disturbing action on the horizontal force is to that of the sun as 1 to 20.

We have just been considering the irregularities in the magnetic action of the sun and moon, which arise from the orbital motions of the earth and its satellite, and from the rotation of our globe, but there are still other variations depending on much more complex causes that remain yet to be examined. A very important inequality has been detected in the daily range by several observers, and of late years by Mr. Chambers of the Colaba Observatory. It is a change that takes place in the amplitude of the range, not from season to season, but from year to year, and which completes its cycle in ten or eleven years. Other periodical inequalities of the daily range have been more than suspected, as that of twenty-two years, noticed by Hansteen; and some of these may possibly be found to have a connection with such phenomena as the revolution of the moon's nodes. It will suffice to have mentioned these; but we must not so lightly pass over the decennial period, which is identical with the cycle of those great but irregular disturbances of which we must now say a few words.

The accurate study of magnetic storms was nearly impossible before photography was called to the aid of the observer; but now that every movement of the needle is faithfully recorded by the ever watchful light of the gas jet, a continuous curve shows at a glance the nature, extent, and duration of even the slightest disturbance. The arrangement of these self-recording magnets is extremely simple and equally effective. To each magnet, whose movements we desire to study, is attached a small mirror, and the rays from a gas jet falling on the mirror are sent by it to a cylinder covered with sensitised paper. A lens brings the rays to a focus on the cylinder, and this focus traces on the paper every movement of the magnet. A second mirror fixed immediately underneath the first, but having no connection with the magnet, sends the rays of the gas jet always in the same direction, and thus traces a base line from which the variations of the magnetic curve can be measured with the greatest exactness. A clock turns the cylinder through a complete revolution in twenty-four hours, and the light being cut off for a few minutes every two hours, breaks are thus made in the curve, which serve as an excellent time scale. The magnetic curves, traced in this manner, are in general and lightly irregular lines, which reach their highest point towards 2 P.M., and are more or less curved at all hours of the day. Scarcely a day passes without some apparently accidental departure from the ordinary bend of the line, but these disturbances are often only of short duration. There are, however, occasions on which the magnets seem to be subject to the action of a disturbing force far exceeding in intensity any of those we have been hitherto considering, and subject itself to no apparent laws, but causing the needle not unfrequently to oscillate through several degrees of arc on either side of its mean position. It will be interesting to know what account can be given of this disturbing power, which assumes such Protean shapes, at one time raising a storm that dies away as gradually as it commenced, and at another bursting forth in an instant in all its fury; now continuing its disturbing action for days together, and then imparting but a single momentary impulse; affecting sometimes one element, and then another, and sometimes all together; and finally appearing not unfrequently at the same hour on several successive days.

The coincidence of these disturbances with the passing of earth currents, so perfectly recorded on the Greenwich curves; their never-failing appearance at all auroral displays; their simultaneous occurrence at places the most remote from each other; and lastly the agreement of their period of variation of intensity, as well as their maxima and minima with the decennial period, and the maxima and minima of sun-spot development; all these facts will be most powerful aids towards the solution of our difficulty. Neither is it unreasonable to expect that some light may be thrown upon the question, if we examine with careful attention the not impossible connection of magnetic storms with solar outbursts, or with volcanic eruptions and violent earthquakes, with the variations of the wind, or even with the showers of falling meteors. Much of interest has already been ascertained in connection with these several points, but I will not tax too severely your indulgent patience by entering at present into these details.

I must, however, before concluding, allude for one moment to those researches of De La Rue, Stewart, and Loewy on solar physics, in which they have made a first step towards establishing a connection between the period of solar spots and the relative position of the planets. If this can be maintained; if the solar disturbances are in any way due to the combined action and reaction of the planets, and these again are found to be coincident with the great perturbations of terrestrial magnetism, shall we not be inclined to attribute a wider range to the magnetic force than is in general assigned to it? May not that, which has long been allowed to rank among the most extensively diffused of nature's agents, find a home in each individual member of the solar system, causing them to act and react upon each other as well by their magnetic energy as by their force of gravity? The perfect solution of such a problem would well repay many a year of persevering observation and of assiduous study, and well will those be rewarded by whose labours the general cause of terrestrial magnetism ceases to be one of the unsolved mysteries of cosmical physics.

SCIENTIFIC SERIALS

No. 3 of the *Bulletin de l'Académie Impériale des Sciences de St. Petersburg*, t. xvii., contains seven anatomical papers by Dr. Wenzel Grüber—six on various abnormal muscular forms, and the seventh being an account of the formation of supernumerary wrist-bones.—An appreciative paper on Sir Roderick Murchison is communicated by G. Helmensen. He refers to Murchison's visits to Russia between 1840 and 1845 to study the palæozoic formations. In a *résumé* of results, he mentions, among others, the discovery, in post-pliocene strata in the lower course of the

Dwina, of the shells of species still extant in northern seas; of a Jurassic formation in large zones and fields between the Volga and the Timan Hills, at the western base of the Urals, and in the north-east part of the Caspian lowland; and of two quite distinct coal beds in Central Russia. The writer considers that the work of our countryman has been imperfectly followed up these twenty-five years. He speaks in warm terms of Sir Roderick's friendship for the Russians.—In a note by M. Jacobi, it is suggested to apply galvanoplastic art to the production of standards of length, on the principle that electrodes having the same dimensions and position, baths the same composition and temperature, currents the same intensity, the deposits produced in such circumstances ought to be very nearly equal. Details of such a method are fully given.—A lengthy article by Dr. Hildebrand gives an outline of some 600 historical documents among the archives of the town of Revel, which throw considerable light on the commercial relations of Russia and Livonia in the fifteenth and sixteenth centuries.—The number contains, in addition, two short notes on Faye's comet and the Fossil Cetacea of Europe.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, Jan. 6.—Prof. Westwood, president, in the chair.—Mr. McLachlan exhibited a collection of coloured figures of the transformations of twenty-one species of Japanese *Sphingidæ*, beautifully executed by a native artist employed by Mr. George Lewis, long resident in Japan. Prof. Westwood exhibited the net-work cocoon of a small moth from New Granada, attached to a leaf on which was also placed the body of a butterfly (one of the *Hesperidæ*), strongly affected by fungoid growths. Mr. E. Saunders exhibited two species of *Buprestidæ* from the Pelew and Caroline Islands respectively, apparently belonging to a new genus, yet resembling, in external characters, two species of *Chryovdema* from the E. India Islands.—Mr. Champion exhibited two species of *Coleoptera* new to Britain.—Mr. Miller called attention to a recently printed Government report respecting the ravages of the vine-scourge (*Phylloxera vastatrix*). An interesting discussion took place, in the course of which Prof. Westwood stated that, to the best of his belief, the first notice of its occurrence in Europe was made by himself in a paper read before the Ashmolean Society of Oxford regarding its ravages in this country.—Dr. Sharp communicated a paper on the water-beetles of Japan, in which he mentioned that, although there were many European species occurring in the Japanese Islands, yet there was also a considerable admixture of Asiatic forms.—Mr. Wollaston followed by a paper on the *Cossonidæ* of the same islands. He stated that the ordinary European types of that family do not prevail in Japan, but are replaced by kindred or representative forms. Mr. Pascoe thought that the fauna of Japan, like that of Madagascar or New Zealand, might be termed a satellite fauna, which, while having many endemic forms, had yet a great deal in common with the neighbouring continent. Mr. Bates asked that judgment upon the question be suspended; although many Western European species were also found in Japan, the collective faunas of the two regions were totally different, and if they found only one fauna in common, the majority of the genera ought to be the same, which was apparently not the case.

PHILADELPHIA

Academy of Natural Sciences, June 11, 1872.—Professor Cope offered some remarks on the discoveries recently made by Professor Marsh as to the structure and characters of the *Pythonomorpha*, based especially on material recently obtained by him in Kansas. As the writer had recently passed in review much similar material, he was much interested in Prof. Marsh's conclusions. These, he said, were of importance. In the first place, he had ascertained that what was formerly supposed to be the inner side of the quadrate bone was the outer side, a conclusion Prof. Cope thought entirely consistent with the other known relations of the parts. Secondly, he had discovered the stapes, and had entirely confirmed the opinion of the speaker, which Prof. Marsh had apparently overlooked. This was stated as follows:[*] the quadrate "is characterised by the presence of an oval pit . . . Its use is uncertain, but there is some probability that it received the extremity of an osseous or cartilaginous styloid stapes. A groove on the under side of the suspensorium would accommodate such a rod, and in a position nearly similar to that which it occupies in many of the Ophidia." It is in precisely this position that Prof. Marsh is so fortunate as to have discovered it. Thirdly, Prof. Marsh believes that he has found the columella. I have supposed it to be wanting, from the absence of its usual points of attachment on the parietal and pterygoid bones. It remains to compare the bone found by Prof. Marsh with ali-and orbito-sphenoid and ethmoid ossifications found in many saurians. Fourthly, Prof. Marsh has observed the parieto-quadrate arch described by the speaker, and makes the interesting observation that it is formed of three elements, the median connecting the parietal with the opisthotic. This piece, he says, is "apparently the squamosal;" as the latter bone completes the zygomatic arch, it cannot occupy a position in the parieto-squamosal, unless it sends a branch in that direction. Fifthly, he discovers the malar arch, proving it to be incomplete and supported by the postfrontal bone. Prof. Marsh also observes an ossification in the glenoid cavity of the opisthotic, which he regards as the pterotic (of "Huxley," which should be Parker), an identification which cannot probably be maintained. The connections of the pterotic, where present. are very different. The bone in question is present in *Edestosaurus tortor* Cope. Sixthly, Prof. Marsh completes almost entirely our knowledge of the anterior limbs. The previous descriptions of these members in *Clidastes propython* Cope, *Holcodus ictericus* Cope, and other species, had left the number of phalanges and their relative positions, as well as those of the carpals, uncertain; these points are now happily supplied by Prof. Marsh's important researches. Seventhly, he has done much for the pelvic arch and hind limbs. He was the first to announce the existence of both, and actually described the pelvis of *Edestosaurus dispar*; the speaker, however, first described the hind limb in *Liodon crassartus* and *L. dyspelor* Cope. Prof. Marsh is in error when he says the "absence of these extremities in the *Pythonomorpha* was considered satisfactorily established." I had never stated that they were certainly absent, and the last time I wrote observed that this order "possessed an anterior pair only, or with the posterior pair so reduced as to have been insignificant."[*] They appear, according to Marsh, to have been relatively small in some of the genera. In *Liodon dyspelor* Cope, the anterior are the smaller. Prof. Marsh lays students under especial obligation for his determinations of the pelvic elements and the excellent figures of all the parts connected with the support of the hind limb. His figure of the fore limb is also highly important, as it will be difficult soon to duplicate his beautifully complete specimen. In subsequent pages there are six additional species described, bringing up the number from the Kansas Cretaceous to twenty-three. Two new genera are proposed, viz., *Lestosaurus* for those previously referred by myself to *Holcodus* Gibbes, and *Rhinosaurus* for species allied or belonging to *Liodon*. As to the former, it is no doubt a well-marked genus, and I am willing to believe Prof. Marsh's opinion, that it will not include Gibbes' *Holcodus acutidens*, will turn out to be well-founded; but there is, on the other hand, insufficient evidence to show that it is not *Platecarpus* Cope. If *Liodon curvirostris* be referred to it, it will very probably prove to be *Platecarpus*, as that species presents palatine teeth, much as in *P. tympaniticus*, and the pleurodont character is not wanting in some of the other species. *Rhinosaurus* includes such species as *Liodon proriger* Cope. As the name has been used two or three times before, it may be altered to *Rhamphosaurus*, but I have always had doubts that the conic projecting snout would distinguish the species generically from the true *Liodon*, with which it agrees in dentition. The type of *Liodon*, *L. anceps* ord., is, however, very little known.

PARIS

Academy of Sciences, Dec. 23, 1872.—M. Faye, president, in the chair. M. Mathieu presented the *Connaissance des Temps* for 1874 from the Bureau des Longitudes; Lieutenant Fleuriais' determinations of the meridians of Shang-hai and Pondicherry are adopted in this number. The president then read a paper on the true position of the Bureau des Longitudes. It has been proposed in the National Assembly to suppress the Bureau in order to save its cost to the nation, the president's paper was an eloquent defence of and appeal for the threatened institution.—M. Becquerel read a paper on the use of electro-chemical and electro-capillary force for the formation of amalgams and crystalline bodies of definite composition.—M. Phillips read a paper on the flow of liquids from reservoirs, maintained at a constant level, through a large orifice in a thin side.—A report on M. Arn. Thenard's researches on the effect of electric discharges on gases and vapours was next read. The author worked with a modification of Houzeau's ozonising tube; he found that a gentle discharge acting on a slow stream of carbonic anhydride decomposed 26·5 per cent. into carbonic oxide and oxygen. De Saussure, working with sparks, never succeeded in decomposing more than 7·5 per cent. A long-continued discharge acts on the glass tube and covers it with powder, and when in this state the decomposition resembles that produced by sparks, the removal of the deposit restores the original power.—M. Janssen read the first part of a report on the eclipse of December 12, 1871.—An essay on the interdependence of meteorological phenomena by Father Solaro was sent to the Physical section.—A letter from M. Denis on certain deductions tending to simplify the principles of natural philosophy was referred to a special commission.—M. Rouget's note on a theorem which extends to imaginary roots the method given by Sturm for real roots, was referred to M. O. Bonnet.—M. Yvon Villarceau presented an account of the discovery and observations of Planetoid 128 at Ann Arbor by Mr. James Watson, and also some observations of 128 made at Marseilles by M. Borrelly.—M. F. Perrier read a note on the Astronomical station of Dar-Baida near Oran.—M. Laussedat read some observations on the prolongation of the French Meridian into Spain and Algeria.—Colonel H. Levret followed with some observations on M. Laussedat's paper, and a letter to Colonel Levret on the same subject from General Blondel followed.—Next came a note on celestial mechanics by M. Newcombe.—M. de Pambour read a note on the calculus of effects by the method of coefficients applied to water wheels.—M. Wurtz presented a note by M. Gariel on the distribution of magnetism in magnets, which was followed by a new note on the action of conductors placed symmetrically about an electroscope by M. Ch. V. Zenger.—M. Balard presented a note on a new application of silver salts for the production of designs, by M. Renault. The author describes a new method of printing from engravings, &c.—A note from M. Schutzenberger on the action of Iodine on certain of the Aromatic Hydrocarbons was then read. A certain quantity of hydriodic acid is formed and acts as a hydrogenating agent.—M. Cahours presented a note by M. Jungfleisch on the Reciprocal Transformation of Inactive Tartaric and Racemic Acids and on the preparation of the former. Inactive tartaric acid is prepared by heating dextrotartaric acid and water to 160° for two days, removing the racemic acid (only a small quantity is formed) by crystallisation, saturating half the liquid with potassic hydrate, adding the other half and separating the very soluble potassium salt by repeated crystallisations.—A note by M. Defresne on the Biliary and Pancreatic Secretions of Omnivorous Animals followed. Next came a paper on Normal Torsion of the Humerus in the Vertebrata, by M. J. Durand.—M. Milne Edwards presented a note on the Structure of the Beak of the *Platalea*, by M. Jobert; and also a note on certain passages from an Arab author of the tenth century, relative to the gigantic birds of South-East Africa, by M. Devic.—A note on the Meteors of November 27, observed at Palermo, by Father Tacchini, was read.

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[*] Trans. Amer. Philos. Soc. 1869, p. 180.

[*] Hayden, Geol. Survey of Wyoming, etc., 1870 p. 385.

DIARY

THURSDAY, January 9.

Royal Society, at 8.30.—Further Researches on the Sense of Sight in Birds: Dr. R J. Lee.—Confirmation of the Existence of an Intra-Mercurial Planet by means of the Behaviour of Sun-spots: W. De La Rue, B. Stewart, and B. Loewy.—On the Union of Ammonia-Nitrate with Ammonia: Dr. E. Divers.—On a New Method of Viewing the Chromosphere: J. N. Lockyer and G. M. Seabroke

Society of Antiquaries, at 8.30.—Further Particulars Respecting the Early Discovery of Australia: R. H. Major.

Royal Society Club, at 6.

Mathematical Society, at 8.—On Parallel Surfaces: S. Roberts.—Summation of certain Series: Prof. Wolstenholme.

Royal Institution, at 3.—Juvenile Lectures—On Air and Gas: Prof. Odling.

FRIDAY, January 10.

Quekett Club, at 8.

Astronomical Society, at 8.

SATURDAY, January 11.

Royal Botanic Society, at 3 45.

SUNDAY, January 12.

Sunday Lecture Society, at 4.—The Musalmans of India and Centra Asia: Dr. F. J. Mouat.

MONDAY, January 13.

Royal Geographical Society, at 8.30.

Medical Society, at 8.

London Institution, at 4.—(Holiday Course, II.).—On Air, Earth, Fire, and Water: Prof. Armstrong.

TUESDAY, January 14.

Royal Medical and Chirurgical Society, at 8.30.

Photographic Society, at 8.—On the Photographic Operations of the Royal Observatory at Greenwich with Astronomical and Meteorological Records: J. Glaisher.—The Fading of Albumenised Pictures: E. J. Gayer.

Society of Civil Engineers, at 8.

Royal Institution, at 8.—On the Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, January 15.

London Institution, at 7.—Ancient Science: G. F. Rodwell

Meteorological Society, at 7.—On Solar Radiation: Rev F. W. Stow.—On Temperature in Sun and Shade; an Account of Experiments made at Harpenden, Herts: Rev. F. W. Stow.—Remarks on the Pocky Cloud, observed July 27, 1872: J. S. Harding.—Account of Hurricane in Western Australia: R J. Sholl.

Society of Arts, at 8.—On the Sulphur Deposits of Krisuvik, Iceland; Charles W. Vincent.

THURSDAY, January 16.

Royal Institution at 8.—On Oxidation: Dr. Debus.

Zoological Society, at 4.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

Linnean Society, at 8.—On the Recent Synonyms of Brazilian Ferns: J. G. Baker.

Chemical Society, at 8.—On Ethylamyl: Mr. Grimshaw.—On the Heptanes from Petroleum: C. Schorlemmer.—On the Vanadates of Thallium: T. Carnelley.—On the Formation of Sulphide of Sodium by the Action of Sulphuretted Hydrogen upon Sodium Chloride: C. T. Kingzeth.

Numismatic Society, at 7.

Royal Society Club, at 6.

BOOKS RECEIVED

English.—The Gospel of the World's Divine Order: D. Campbell (Trübner).

PAMPHLETS RECEIVED

English.—Natural History Transactions of Northumberland and Durham, Part 2, Vol. iv. (Williams & Norgate).—Workman's Magazine, No. 1: (Kent).—Transactions of the Institute of Engineers and Shipbuilders in Scotland.—Popular Science Monthly, No 9.—Little Hodge: Author of "Ginx's Baby" (King).—Astronomical Register, No 121.—Journal of Botany, No. 121.—Society of Telegraph Engineers; Annual Report.—Evidence for the Ice Sheet in North Lancashire and adjacent parts of Yorkshire and Westmoreland: R. H. Tiddeman.—Note on an Experiment to predict the Annual Rainfall: W. Pengelly.—Rainfall on the St. Mary Church Road, Torquay, during the Eight Years ending Dec. 31, 1871: W. Pengelly.—Literature of the Oreston Caverns near Plymouth: W. Pengelly.—Is it a Fact? W. Pengelly.—Signs of Hotels, Taverns, Inns, &c., in Devonshire: W. Pengelly.—On the Kombé Arrow Poison (*Strophanthus Hispidus*, D.C.) of Africa: Thos R. Fraser, M.D.—Messenger of Mathematics, No. 20.

American.—American Naturalist, vol. vi. No. 12.—American Journal of Insanity, vol. xxix. No. 2.—Penn Monthly, Nos. 29—33.

Foreign.—Journal de Physique, No. 12.—Nuovo Giornale Botanico, vol. iv. No. 4.—Bulletin de l'Academie Royale des Sciences de Belgiquer No. 11.—Bulletins de la Societé d'Anthropologie de Paris, Nos. 1-4.—V. der K. K. Geologischer Reichsanstalt, No. 16.—Poggendorff's Annalen der Physik und Chimie, Nos. 12 and 13.

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THURSDAY, JANUARY 16, 1873

THE INTERNATIONAL METRIC COMMISSION

THE methodical statement of the resolutions passed by the International Metric Commission at their meeting in Paris last October, has already been given in NATURE, vol. vi. p. 544. From this statement, a general idea may be formed of the extent and importance of the operations to be carried out under the superintendence and direction of so many eminent men of science, for the construction and verification of new international standards of metric weight and measure. We may thus hope eventually to see a real and practical uniformity established in the weights and measures regulating all transactions of trade and commerce between the several countries of the world, as well as in those used for all constructive works and technical instruments of various descriptions, and in scientific investigations and researches. Such a result of the labours of the Commission will be one of the greatest triumphs of modern civilisation. We may better estimate its value and importance, if we consider that it will create a universal language, so far as regards expressing any required quantity of material things capable of being measured or weighed, and this in terms at once intelligible to every one; and it must afford the means of immensely extending and diffusing useful knowledge, and facilitating its acquirement.

The statement before referred to contains the text of the formal decisions of the Commission upon the several points involved in the immediate duties which have been entrusted to them; that is to say, the construction of the new international metric standards, and the establishment of their identity or their equation by the most perfect instruments and from the most accurate comparisons. In the accomplishment of these objects, all the best appliances of modern science will be employed. It will be seen, also, that the Commission further propose to adopt the most effectual means for maintaining inviolate the uniformity of the new standards of weights and measures, through the agency of an International Metric Institution to be permanently established at Paris. This institution is to be placed under the direction of a permanent committee, which has been already chosen by the Commission from among their own body. Among the members so elected are the chief officers of weights and measures in the principal countries of Europe, and in the United States of North America. To this International Metric Institution it is proposed to entrust the custody of the new prototypes of metric weight and measure, and to furnish to its officers the means, and impose upon them the duty, of making all such further comparisons of the several international standards with the prototypes and with each other as may be required. Regulations are also to be laid down by the Commission for guaranteeing continued uniformity and invariability of these international standards.

But probably many persons in this country will say—Of what use to us will be the making of all these new metric standards, and the creation of this new International Metric Institution? We have our own Imperial system of weights and measures, as well as national standards, and are quite satisfied with them; why should we want any metric weights and measures? Now, in the first place, without discussing the disputed question of the introduction of the metric system, with its uniform decimal scale, into this country, it may be pointed out that any notion of forcing the extensive adoption of the metric system upon the English people in opposition to public opinion, has been altogether disclaimed by the authorities. In the late annual address to the Royal Society by its president, the Astronomer Royal, printed in the Society's Proceedings on Nov. 30, 1872, he said, with reference to the International Commission for the establishment of new and uniform *Standards* of the Metric System:—"I think it imperative on me to state that the British Government gave their assent only on the express understanding that they could take no part in the Commission if it displayed any propagandist intention. Speaking as the representative of the body who had best considered this subject, namely, the Standards Commission now dormant, I can say as their unanimous opinion that they deprecate the slightest interference with national usages; but they recognise the great importance of an accurate international system which, like the Latin of the Middle Ages, enables men of science to speak the same language: and for this international character they think the metric system singularly well adapted." But, in point of fact, whether we adopt the metric system to a greater or less extent, and sooner or later, in this country, or not, it is quite evident that as it has been adopted by almost every country on the Continent of Europe, and that all the necessary steps have been taken for its adoption in the United States of North America, in Canada, and in British India, thus establishing its international character, it must be of the greatest advantage to us in all commercial transactions with countries abroad, including the computation of Customs duties, to be able to deal with their commodities when weighed or measured, everywhere by one uniform standard. This advantage must, at any rate, be allowed, even if we continue to stick to our imperial weights and measures. In dealing also with technical and scientific instruments, and with computations of quantities in technical and scientific investigations, it must be of great importance to us here in England to find quantities of measure or weight everywhere else expressed in the same terms. These considerations tend to show, even to the upholders of our imperial system of weights and measures, the great benefits that must result to this country from the adoption everywhere abroad of uniform weights and measures; based on standards the identity of which, and its maintenance, will be guaranteed by the International Metric Commission and their permanent institution. They also show how impossible it must be for this great commercial country to remain in a position of isolation with regard to this large international question, and the necessity of our adopting this uniform system of weights and measures, at least for all purposes of an international character.

There are other important advantages proposed to be obtained by establishing the new International Metric Institution, the benefits of which will extend to this country as well as to other countries. Many scientific questions connected with the accurate comparisons of Standard weights and measures now require an authoritative decision, with a view to their general adoption. These constitute the data upon which the requisite corrections of the actual results of the several comparisons must be computed, before an accurate determination can be arrived at, with reference to the circumstances under which the comparisons are made. Amongst these questions may be instanced: The determination of the true weight of a given unit of measure of dry atmospheric air; the true weight of a given unit of measure of pure water; the condition of pure water employed in Standard operations, as to its being more or less deprived of or saturated with air; the rate of expansion of air; the rate of expansion of water and of its maximum density; the amount of aqueous moisture in atmospheric air and its influence on the weighing and measuring of Standards; the relative rates of expansion generally of solid, liquid, and aëriform bodies, and the limits of temperature within which this rate is to be determined; more particularly, of the relative expansion of the quicksilver and glass of thermometers, and the constancy of the determined rates of expansion; the constancy of the determined length of Standard measuring bars, and of their coefficients of dilatation; the adoption of a uniform average rate of expansion, within determinate limits of temperature, of metallic and other bodies used in Standard operations; and of average conditions of temperature of these bodies and of the medium in which they are placed; the employment of an air thermometer, &c. &c. At the present time, different solutions of these questions are adopted in the several countries, the results being that not only is any uniform agreement in the results of comparisons rendered absolutely impossible, but doubts exist as to the accuracy of the determinations of these questions which have hitherto been made. It is evident that in order to obtain any satisfactory solution, long and varied observations and comparisons will have to be made, and such labours are proposed to form an important part of the future work of the International Metric Institution. It is only by such an authoritative determination made by the combined efforts of men of science in the different countries, under whose direction the Institution is to be placed, that the urgent need of uniform and accurate data for obtaining trustworthy results in all comparisons of Standards can be expected to be supplied.

It ought, however, to be distinctly understood that not only the more immediate operations of the International Metric Commission, but also the proposed future operations of the International Metric Bureau, under the directions of their permanent committee, are wholly and exclusively of a scientific character. The objects of the Commission are to furnish and to afford the means of maintaining uniform standards for all countries which have already adopted, or which may hereafter adopt, the metric system, as either a national or international system of weights and measures. The true sphere of the Commission is thus limited to the investigation and accomplishment of all the best means, either in a scientific or a technical point of view, by which these objects may be attained. Whether the adoption of the metric system of weights and measures by this or any other country be advantageous to it or not is a question to be determined by each country upon its own merits, but it is one with which the International Metric Commission is no way called upon or entitled to interfere.

An incident which occurred at the late meeting of the Commission may be noticed as showing how strictly their objects were considered by them to be confined to purposes of science. The question of the mode of voting having been raised, it was referred to a committee to report upon. The Committee recommended, and the proposition was unanimously agreed to by the Commission, that on ordinary occasions each member present should vote personally; but upon the demand of five members, the votes should be taken by countries represented, each country having one, two, or three votes, according to the population. Amongst others, one vote was assigned to the Papal See, represented by Padre Secchi, who had originally been appointed delegate of the Papal States. Unfortunately a report of these proceedings appeared in the *Journal Officiel*, though not in the official portion, and attracted the notice of the Italian Parliament then sitting, when the Italian Government was instructed to insist on the cancelling of the vote for a nation given to the representative of the Papal See, the Pope being no longer a territorial Sovereign. A diplomatic communication was accordingly made to the French Government, who declined to interfere in a matter within the power of the International Commission, and which had reference merely to the proceedings of a scientific body. The Italian Government then directed their representatives to take no further part in the Commission, so long as Padre Secchi continued to be the delegate of the Papal See, and Marquis Ricci and Prof. Govi were reluctantly compelled formally to announce this to the Commission. But the Commission felt that they could only deal with this communication as an accomplished fact, and they expressed their great regret at this secession, in consequence of imperative orders, of two of their most eminent colleagues, which they trusted would be only temporary. They at the same time expressed their astonishment at so unlooked-for an interference with their proceedings which were of so entirely a scientific character.

The extent of the preliminary work hitherto accomplished by the Commission may be estimated from the fact of their Minutes of Proceedings during the last four years filling 580 closely printed 12mo. pages. On the occasion of their recent meeting, when the Commission was found to comprehend 50 members, representing 29 of the principal countries of the civilised world, the subjects of the formal resolutions passed by them had been previously arranged for their discussion and deliberation, and were referred by them to eleven different Committees. The Reports of these Committees, which are printed at length in the *Procès-Verbaux* of the Commission, contain the form of the Resolutions under each subject which was proposed for adoption; and, generally speaking, they were unanimously passed by the Commission, with but slight amendments. The grounds of the conclusions arrived at by the several Committees are stated at length in their Reports, and in a future article some of the more important of them of the highest scientific interest will be specified.

H. W. C.

MINERAL PHOSPHATES

Mineral Phosphates and Pure Fertilisers. By Campbell Morfit, M.D., F.C.S. (London: Trübner and Co.)

THE date of the patent taken out by Mr. Lawes, in 1842, for treating mineral phosphates with sulphuric acid, has proved the date of the commencement of a new industry which has now attained to vast proportions. At present the manufacture of superphosphates in Great Britain can hardly be short of 400,000 tons per annum, and the market value of the same cannot be under 2,400,000*l.* Competition naturally tends to develop improvements, and of late years several novel processes have been suggested for the better treatment of mineral phosphates. Dr. Morfit's book is mainly devoted to a description of these new methods, and more especially to a detailed account of the practical working of his own inventions. The object of all these processes is the preparation of "Pure Fertilisers." The mineral phosphates at the disposal of the manufacturer contain 50-80 per cent. of tricalcic phosphate, the poorer minerals preponderating. In making ordinary superphosphate the whole mineral is treated with sulphuric acid, and the resulting superphosphate is of course rich or poor according to the quality of the mineral taken. But in making a "Pure Fertiliser" the aim is to separate the calcium phosphate from the original mineral and offer it for sale in a nearly pure state. The production of a pure phosphate is of course a more costly operation than the simple treatment of the powdered mineral with sulphuric acid, and we believe that these pure fertilisers will consequently not be able to compete with ordinary superphosphate, except in cases where, as in America, the manure has to be transported over great distances, and small bulk is therefore a desideratum. Their advantage over the comparatively poor superphosphate is much lessened by the fact, that the non-phosphatic matter in superphosphate is principally gypsum, which is itself a valuable manure. There is one class of mineral phosphates, however, which is wholly unsuited for the manufacture of superphosphate—we allude to the native phosphates of aluminium; the processes patented by Mr. P. Spence and Mr. J. Townsend for the extraction of the phosphoric acid are in this case most valuable.

Dr. Morfit's plan is to roast the powdered crude calcium phosphate, then dissolve it in strong hydrochloric acid, and precipitate the solution by ammonia gas, by lime, by whiting, or by the addition of a previously precipitated mixture of the oxides and phosphates of iron and aluminium. When the solution is left acid by an insufficient use of lime, or when the last two precipitants are employed, the precipitate obtained consists chiefly of dicalcic phosphate. The resulting calcium phosphate is either sold as such, or else converted into a superphosphate. The acid mother liquors are precipitated with lime, which throws down the iron, aluminium, and remaining phosphoric acid; the purified calcium chloride is then boiled down and brought into a solid state for sale. There is thus a constant production of two bye-products. The author regards them as valuable materials; the calcium chloride is to be used for making Ransome's artificial stone, and the ferruginous phosphates for the clarification of sewage. This scheme looks promising on paper, but must require special local circumstances for its fulfilment.

The reader will find in this book a full account of the patents of Way, Spence, Townsend and others, who have worked on the subject, together with much practical information as to the construction of apparatus and the performance of manufacturing operations; the subject is, in short, fully treated. The book contains, however, some very unpractical schemes, as when the author proposes the universal adoption of earth closets, with the recovery of the nitrogen by combustion with soda-lime, and the production of phosphoric acid by lixiviation of the residue. Now as fully saturated closet earth contains, according to Voelcker, but ·33 per cent. of nitrogen, and ·55 per cent. of phosphoric acid more than the loam originally taken, the notion seems to us somewhat impracticable. The book also contains, we are sorry to say, examples of doubtful chemistry.

We refer in conclusion to some statements which we consider to be errors in the volume.

Dr. Morfit gives proportions for the preparation of manures for all the ordinary crops; these proportions are professedly based on the composition of the crops themselves. All these mixtures contain large amounts of potash, and the manures for wheat, clover, and turnips all contain the same amount of nitrogen. Having said this, we have made it plain to every scientific agriculturist that the author's notions are quite unpractical; he has, in fact, fallen into the common mistake of chemists who know little of agriculture. If manures are to be constructed on the basis of returning to the land what has been taken from it, we have then to look at the composition of the materials sold off the farm, and not at the composition of the crops grown, as these are in great part consumed on the farm itself. But even this is not the practical aspect of the case. Each crop has, in fact, a characteristic capacity for self-supply; it obtains with ease some portions of its food, and others with difficulty; the aim of economic manuring should therefore be to supplement the plant's weakness. Thus, wheat supplies itself with difficulty with nitrogen, while clover has a wonderful power of self-supply in this particular. The scientific farmer therefore manures wheat liberally with nitrogen, and gives little or none to clover. The mere chemist would do just the reverse, as clover contains much more nitrogen than wheat. Manuring, on the principles of the author, is simply impossible; the manures would often cost more than the increase of crop obtained.

Dr. Morfit again finds fault with the ordinary commercial analyses of phosphatic materials, and devotes a whole chapter to directions for the analysis of mineral and other phosphates. We strongly recommend the reader not to follow Dr. Morfit's guidance. It is quite impossible to enter here into details of the doubtful chemistry that occurs throughout the chapter, but we may refer to one point which governs many of the author's conclusions. He professes to ascertain the "individual combinations of the phosphoric acid present," a task which other chemists would probably express their inability to do. He accomplishes this by assuming that the phosphoric acid which is precipitated as ferric phosphate in his analysis, existed in the same state in the original mineral. By this means, and by assuming in the same way that other precipitates truly represent the original compounds, the task becomes quite easy. It follows naturally from these assumptions that the acids determined in the mineral are found insufficient for the lime present; the existence of organic acids is therefore next assumed, and "organate of lime" appears in the author's analyses as an ingredient of mineral phosphates! R. W.

LIGHT SCIENCE

Anecdotal and Descriptive Natural History. By A. Romer.—*The Ivy.* A Monograph. By Shirley Hibberd.—*Buds and Blossoms.* Stories for Children. —*Fairy Mary's Dream.* By A. F. L. (Groombridge and Sons.)

IT is very gratifying to see works of the above class brought out,—books which it is supposed, are calculated to amuse as well as instruct. Ten years ago they would have been a dead loss to the publisher, and their publication now is one of the surest proofs that science is permeating all classes and is appreciated by persons of all ages.

Mr. Romer's beautiful book explains in the introductory chapter in a clear and simple manner the classes and orders of the Animal Kingdom, and then goes on to describe the haunts and habits of the best known frequenters of the jungle and prairies, such as the lion, cheetah, and rhinoceros, giving particular attention to the monkey tribe and bears. The book is enlivened by numerous anecdotes and contains coloured plates and wood engravings.

"The Ivy" is a monograph comprising the history, uses, characteristics, and affinities of the plant, and a descriptive list of the garden ivies in cultivation. The book is most luxurious and tasteful, both in binding and letterpress. The plates, coloured with great delicacy, represent the various kinds of ivy, and so natural are the leaves, that one is almost tempted to take one up. A coloured sketch of the Entrance Gate of Conway Castle, surrounded by specimens of ivy, forms the title-page; the letterpress is thickly interspersed with sketches of "ivied castles, and churches, and quotations from Virgil, Euripides, Harleian Manuscripts, Shakespeare, Wordsworth, and the modern poets." An interesting part of the work is the author's historical and literary memoranda from the times when the ivy was called "the plant of Osiris" by the Egyptians down to the time when its praises were sung in that famous song, by Charles Dickens, "The Ivy Green."

"Buds and Blossoms," a book containing ten stories, will be a welcome addition to a child's library; the last, called the "Fir-tree's Story," being particularly pretty. This little volume contains several coloured plates and woodcuts, and the title-page is gracefully illuminated.

"Fairy Mary's Dream," another charming book for children, is in the form of a poem. The illustrations are well done. The colouring of the peacock's feathers on the title-page and in the plate "Till on a green fern's nodding crest" is exquisite; and besides the plates there are many engravings descriptive of the butterfly's journey.

W. L.

OUR BOOK SHELF

Pathologische Histologie der Luftwege und der Lunge. Von Dr. Albert Thierfelder. Atlas of six plates (Leipzig, 1872).

ALTHOUGH death and disease are as much a part of Nature as life and health, yet it is found convenient to separate the study of living structures under morbid conditions from the rest of biology, so that a work like the present must in these pages be more briefly noticed than its importance would deserve.

It is more than fifteen years since the publication of the late Prof. Förster's Atlas of Morbid Histology; and when we consider all that has been done in that time, represented in such volumes as those of Virchow, of Förster himself, of Rindfleisch, of Cornil and Ranvier, we see ample reason for the issue of a new series of plates illustrating the subject. The present *Heft* is the first instalment of the complete work, which is to consist of ten such, each complete in itself. The drawings are admirably executed both by Dr. Thierfelder and by the engraver. The text is strictly limited to explaining them, and is therefore much shorter than in Eiker's physiological atlas, for instance; but in the present state of pathology we regard this as a merit. The selection of subjects for illustration is always difficult: it might be objected that some of these drawings (*e.g.* fig. 2 of Pl. I.) represent little but normal tissues; but, on the whole, practical pathologists will not have room to complain on this score. Some patriotic anatomists will be glad to see "die von den Engländern supposirte Basementmembrane" taking its place without question here. The price of these beautiful plates is very moderate, and we heartily wish Dr. Thierfelder success in completing his work.

Coalfields, Western Port. Report of the Board to the Colonial Government, Victoria.

THE Government of Victoria are determined to find a workable coal-field in that colony, and, apparently not satisfied with the examination of the mesozoic rocks made by the extinct Geological Survey, have had the same strata re-examined by a mining engineer acting under the direction of a Board. The results of these further investigations are embodied in this final Report, but they add little or nothing to our previous knowledge. Indeed the Report seems to be for the most part a work of supererogation. The geological age of the coal-bearing strata had already been definitely ascertained by Mr. Selwyn and his staff, yet the Report goes into this question at considerable length as if it was quite a novelty. Then, as regards the extent of the actually proved coal-seams, Mr. Selwyn, as is well known, expressed an unfavourable opinion. Upon his geological map of Cape Patterson the coal-seams exposed upon the coast are protracted inland so as to show the approximate area over which they extend, and this is only some 106 acres. So experienced a geologist as Mr. Selwyn was not likely to misread the evidence which is so clearly and abundantly developed along the coast. But the Board believe that "any calculations based on the bearings of the strike of seams in this locality are unreliable." There does not appear, however, to be anything specially mysterious and abnormal about the coal-bearing strata of Cape Patterson, nor is there any reason why they should not "behave" like similar deposits elsewhere. The Geological Survey's map shows a very small area of workable coal, and perhaps this is why the strike and dip on the well-exposed coast at Cape Patterson are considered unreliable—the wish in this case being father to the thought. Mr. Selwyn and Professor M'Coy both believed it possible that at some considerable depth below the coal-seams of Cape Patterson a better coal-field might be got. The Board, however, does not think this likely. Here, again, we should be inclined to pay more deference to the opinion of highly trained and experienced geologists than to that of gentlemen, who, whatever their attainments may be, certainly do not in this Report evince much acquaintance with geology. J. G.

Reports of the Mining Surveyors and Registrars for Quarter ending March 31, 1872. Victoria.

THERE is nothing in these Reports calling for special notice. The total quantity of gold got respectively from alluvia (or, as the Reports have it, *alluviums*) and quartz reefs during the quarter were as follows:—Alluvial, 171,851 oz. 10 dwt.; quartz, 164,670 oz. 8 dwt.; total, 336,521 oz. 18 dwt. The quantity of gold, the produce of the colony, exported during the same period was 398,131 oz. 10 dwt.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Aurora Spectrum

IN connection with my letter in last number of NATURE, I have in a diagram approximately placed the aurora lines side by side with the spectrum of hydrogen and of some of the principal air lines (as given in Dr. Watt's index) and with the following results:—

Line No. 1. Close upon, if not identical with, an air-line marked by Huggins N O, and Plücher O.

No. 2.—Not apparently coincident with any prominent air-line. The coincidence with a line of oxygen noted by so careful an observer as Mr. Proctor is puzzling; and if the instrumental power used was sufficient to ensure absolute identity, seems to indicate a second or unusual spectrum of that gas.

No. 3 is not near any principal air-line.

No. 4 is nearly coincident with a faint line of oxygen (confirmatory of Mr. Proctor's observations).

No. 5 corresponds to a rather strong N line.

No. 6 does not coincide with any principal air-line, very faint lines of O and N being the nearest.

No. 7. Upon close examination the positions of this line as respectively fixed by Mr. Proctor and Lord Lindsay are not inconsistent, and the line closely corresponds with a strong line of oxygen situate on the less refrangible side of solar G.

Nos. 1, 4, 6, and 7 fairly correspond in intensity with their representative air-lines. None of the lines are identified with $H\alpha$, $H\beta$, or $H\gamma$, and it would appear that the aurora, if a spectra of atmospheric gases, mainly selects oxygen and ignores $H\alpha$ and the stronger N lines. The modification of compound spectra by conditions of temperature and pressure, is however only a partially explored subject, and we have moreover no certain data of conditions in the case of the aurora, which will assist us in bringing it to bear.

I accidentally omitted from the names of some observers of the zodiacal light that of Prof. Piazzi Smyth, whose observations in the south may be said to have conclusively demolished the supposed identity of the light, and the aurora (at least so far as bright lines are concerned) made it extremely improbable that anything beyond a continuous spectrum will ever be seen in the pure zodiacal light, though a further search should be by no means neglected. J. RAND CAPRON

Guildford, Jan. 10, 1873

Polarisation of the Zodiacal Light and of the Aurora

IN the interesting article by Mr. Rand Capron in the last number of NATURE—after collating the various results of the spectroscopic examinations of the aurora and zodiacal light which have appeared at different times in your pages, together with those which have been collected by Dr. Schellen—he terminates his analysis of the general results by remarking that he is "not aware whether the zodiacal light and the aurora have been examined with the polariscope," and suggests that the "light, though faint, might be tested with a Nicol's prism and Savart's bands."

I would refer him to a paper in the March number of the "Monthly Notices of the Astronomical Society" for 1871, in which an observation by Mr. Burton (late assistant to the Earl of Rosse) on the polarisation of the zodiacal light is described.

Mr. Burton was one of the eclipse party stationed at Agosta, in Sicily. He made use of a Savart's polariscope, set so as to give a black centre where the bands were parallel to the plane of polarisation. On looking to the brightest parts of the zodiacal light Mr. Burton believed that he could detect faint traces of polarisation, sufficiently strong to enable him just to recognise that the bands were black centred when their direction coincided with the axis of the cone of light, that is, when the direction passed through the position of the sun.

To make sure that he was not examining the remains of air polarisation given by the slight remaining twilight, he examined the light of other parts of the heavens, but was unable anywhere else to detect any trace of bands. In contradistinction, however, to this must be set an observation of my own, yielding a negative result, though made on the same evening and with a similar instrument, as well as with the same Savart used by Mr. Burton. I was, however, unable to detect any trace of bands either upon the cones of zodiacal brightness or upon the adjacent parts of the sky; but it is very possible that Mr. Burton's eye may be more sensitive to faint lights than my own.

In February last I also met with a negative result in examining a faint trace of the zodiacal light visible in England. I then used a double-image prism as well as a Savart, thinking that its two oppositely polarised fields in juxtaposition might afford a more delicate test for so faint an object.

Capt. Tupman while cruising in the Mediterranean has also, I believe, repeatedly obtained negative results when making use of a Savart on the zodiacal light.

And I understand that Mr. Lockyer, together with the other observers of the Indian Eclipse of December 1871, totally failed to detect any traces of polarisation in the brilliant displays of the zodiacal light which they observed while crossing the Indian Ocean.

I am therefore disposed to conclude that any traces of polarisation must be very slight, if indeed any polarisation at all is to be attributed to the zodiacal light itself and not to the veil of atmospheric impurities lying between us and objects near to the horizon. Certainly we may conclude that there is no such polarisation as is found in the light of the solar corona or—as we might expect—if the zodiacal light were caused by a great cloud of cosmical dust made up of particles smaller in diameter than the wave-length.

Indeed there cannot be as great a percentage of polarisation, or, to speak more exactly, as great a difference between the component radial to the sun's place and the component at right angles, as in the case of a sunbeam dispersed by the dust in our own atmosphere. For if any one will examine the track of a sunbeam passing through a room with a Savart, he will not fail to be struck with the distinctness of the bands. We seem therefore justified in concluding, that if the zodiacal light is composed of cosmical dust, such dust particles must be considerably coarser than those which float in our own atmosphere.

As to the polarisation of the light of the aurora, I examined, both with a double-image prism and Savart, a faint auroral display on November 10, 1871; as also the light of the great aurora of Sunday, Feb. 4, 1872, but in neither instance was able to detect any traces of polarisation.

A. COWPER RANYARD

The Diathermacy of Flame

THERE are some statements in Capt. Ericsson's reply to my letter (NATURE, vol. vii. p. 149) which demand discussion. In the first place he calculates the supply of gas in *his* pipe and applies it to *my* burners. As his pipe did not supply my flames, but his own, which were at least fifteen times larger than mine, the applicability of his figures is rather obscure.

Capt. Ericsson says, "The apparatus contrived by Mr. Williams for determining the diathermancy of flame, as described by himself, is exceedingly faulty, *the temperature it records being that produced by heat derived from several sources. The radiant heat transmitted to the bulb of the thermometer by the flames, acting conjointly with the unknown degree of heat imparted by the surrounding medium*, it will be evident that Mr. Williams' device is worthless as an indicator of radiant intensity." Does Capt. Ericsson really mean that the maximum temperature indicated by a thermometer exposed to several varying sources of heat is not determined by the maximum radiators or convections of the body capable of communicating the highest temperature, but by this, plus the minor radiators or convections of the cooler bodies? The words I have put in italics distinctly imply such an assumption.

He seems to forget that I did, in the first place, observe and record the temperature of the surrounding medium. It was the 19° C. which served as my starting-point. As no additional radiations were introduced beyond those of the flames to be experimented upon, and the blackened bulb of my thermometer was surrounded by polished reflecting metal surfaces on all sides, except that exposed to the flames, all the subsequent increments of heat were unquestionably due to the radiators from those flames, whether they came directly from the flames themselves or were received and reflected from the back and sides of the polished chamber. Fully admitting the desirability of a continuous record of the heat thus communicated to the surroundings of the thermometer during the experiments, I nevertheless firmly maintain that, rude as it was, my apparatus (I refer, not to the thermometer, but to its adjuncts) was far superior to Capt. Ericsson's. Mine was liable to a small source of error from a possible accidental irregularity of radiation by the thermometer bulb, but his was specially devised to ensure a large amount of such irregularity, continually increasing with the progress of the experiments. It is not a little surprising that so careful and luxurious an experimentalist as Capt. Ericsson should have overlooked the fact, that the very precautions which he so elaborately introduced to secure equal radiation from his bulb are precisely adapted to produce the contrary result.

The arrangements by which his thermometer is "enclosed in an exterior vessel charged with water kept at a constant temperature" of 60° by communication with a capacious cistern, directly violate the conditions demanded by the Newtonian law of radiation, of which Capt. Ericsson is so able a champion; for as the experiment proceeds with an increasing number of flames, and consequent rising of the thermometer, this constant temperature of the water jacket goes on steadily augmenting the difference between the temperature of the bulb and that of its surroundings, and consequently secures just what it is intended to prevent, viz. a variable radiation. What is required to secure a constant degree of radiation from the bulb is not the constant temperature of the surroundings, but a temperature steadily increasing at the same rate as that of the bulb, in order that the *differential* and not the *absolute* temperature of the surrounding medium, &c., should remain constant. This was rudely obtained in my simple apparatus, as both the thermometer and its surroundings were simultaneously influenced by the same radiations.

Capt. Ericsson takes great pains to controvert my "assumption that the intensity of a gas flame is proportional to the gas consumed." This is unnecessary, inasmuch as I never made any such assumption, but have, on the contrary, endeavoured to prove that such cannot possibly be the case, by showing what becomes of the radiations from the interior of a large solid flame. If he will read chaps. 7 and 8 of "The Fuel of the Sun," he will see how and why this has been done, and learn the true bearings of the experiments under discussion upon this subject. W. MATTIEU WILLIAMS

P.S.—The present is a suitable opportunity for asking a question which doubtless the philological readers of NATURE can easily answer. Many writers use the words "diatherma*n*cy," "diatherma*n*ous," "atherma*n*ous," &c., rather than "diathermacy," diathermous," &c. Why is this? We do not say "therm*an*al" or "therm*an*ometer," &c. Why, then, should we depart from the analogy of ancient usage in constructing the more modern compounds of the same root?

Pollen-eaters

MR. HART's note in NATURE, vol. vii. p. 161, is interesting to those who have paid attention to the subject of fertilisation by insect agency, and would be still more so if he could furnish the names of the species of both plants and *Syrphidæ* that have come under his observation.

May I take this opportunity of calling the attention of the readers of NATURE to a suggestion which I made some months since in the *Journal of Botany*, and which has at present met with no response? I believe no greater service could be rendered to this department of physiological botany than a series of observations on the species of insects which frequent and assist in the fertilisation of our wild flowers. I know of no such list even with respect to our commonest flowers. Here is a wide field for observation during the next season.

London, Jan. 7 ALFRED W. BENNETT

P.S.—At the time of writing the above, I had not seen Dr. Buchanan White's article in the January number of the "Journal of Botany," on "The Influence of Insect-agency in the Distribution of Plants," an admirable introduction to the series of papers I had in my mind.

Welwitschia

IF you will kindly permit me, I wish to make an addition to your notice of my paper on "Welwitschia," read at the Linnean Society on the 19th ult. That paper was completed and put in Dr. Hooker's hands about three months ago; and the reading of it was delayed until I had seen Strasburger's recently published memoir on Coniferæ and Gnetaceæ. After perusing that valuable work, I added a small appendix to my paper, and it is to the omission of the remarks contained therein that I wish to direct attention.

In the description of the male flower, Strasburger and I almost completely agree. It possesses two outer parts of the perianth, two inner parts, six stamens, which I believe to arise by branching from two primordial stamens, although Strasburger does not agree with me in this, and two carpels. The formula of the flower may be expressed thus:—

$$\mathrm{Ca}_2\ \mathrm{Co}_2\ \mathrm{An}_2^3\ \mathrm{Gn}_2$$

In the female flower I had very great difficulty in coming to a conclusion as to the value of the two outer parts, but the inner I concluded was a covering of the nucleus, an ovular integument, and not carpellary. There were only two ways of deciding what was the morphological significance of the two outer parts, either by comparison with the male flower, or by comparing them with the parts in the flowers of *Ephedra* and *Gnetum*. I applied to Dr. Hooker for specimens of these genera, and he has kindly promised to procure them for me. As Strasburger's material for the examination of Ephedra and Gnetum was imperfect, it is still of importance to examine both in detail. Being, therefore, obliged to fall back on comparison with the male flower (the study of the development alone not being sufficient for the purpose), I described the two outer parts as forming a perianth, although I could not feel certain that I was correct in so doing, and could not explain the occurrence of the short stalk under them, no such stalk existing in the male. On looking at Strasburger's figures of Ephedra, I at once saw that I had been in error in describing the outer parts as forming a perianth, and in the appendix stated that they were *carpellary*.

The formula would therefore be:—

$$\mathrm{Ca}_0\ \mathrm{Co}_0\ \mathrm{An}_0\ \mathrm{Gn}_2$$

The carpels, therefore, exist in both flowers; but whereas in the male they are anterior and posterior, in the female they are lateral. Kindly make this correction, because I do not think that after Strasburger's magnificent work, the Gymnospermous theory is for a moment tenable.

Should any correspondent be able to obtain specimens of Ephedra and Gnetum for me, I would be greatly obliged, as I am desirous of completing my paper on "Welwitschia" by a description of its embryogeny, as well as that of the other two genera. Specimens which have been put in absolute alcohol are by far the best for examination, but that, I fear, could only be obtained abroad with great difficulty. W. R. MCNAB

Dublin, Dec. 27, 1872

Gauges for Ocean Rainfall

IN reply to Mr. Miller's letter on ocean rainfall, in NATURE, vol. vii. p. 123, I beg to acquaint your correspondent that I have endeavoured to meet the difficulties he mentions, by designing two forms of rain-gauge for use on board ship. One is of a cylindrical form, and composed of a collector and receiver, detachable from each other, and is suspended on gimbals in a frame or vexa. The rainfall may be estimated either by a glass scale at the sides, or by emptying the contents into a graduated glass measure.

A description of this instrument as above designed appeared in the Journal of the Scottish Meteorological Society for January 1870, and was illustrated by diagrams.

The other form consists of the cylinder as above, divided into collector and receiver, detachable from each other, but it is poised on a pivot projecting from the floor below, into a conical cavity in the bottom of the receiver. It is also enclosed in a square box, from which, in each case, the cylinder is removeable entire for emptying the contents, and the rainfall admits of being estimated in the same way by scales or glass vessels.

A full-sized model of this instrument has been made, and was exhibited at the annual meeting of the Scottish Meteorological Society in July last, and a notice of it appeared in the account of the proceedings of the meeting in the Edinburgh papers of July 4, 1872. It has likewise been exhibited at the Meteorological Office, Victoria Street, London, and its construction has been approved of by several naval officers, and others specially interested in rainfall.

I may add that some gauges are being constructed, with the view of being used on board such steamers as would permit of their being placed under the superintendence of interested and scientific officers.

I hope by-and-by to be enabled to present to the readers of NATURE some results of the observations made by these gauges, which may lead to an introduction of such instruments as part of a ship's equipment, and so to put them in possession of some trustworthy observations of the rainfall at sea.

W. J. BLACK

Star Shower in 1838

I AM not sure that the following extract from my note-book may not have been printed by the British Association; but even in that case it may be thought suitable for reproduction at the present juncture.

"1838. Dec. 7.—A great number of falling stars were observed between 6^h and 7^h. In about half-an-hour 40 were counted, sometimes by one, sometimes two, sometimes three observers—two at a medium. They were of all magnitudes up to the first: the larger dissolved into a train of light, but left no train behind them: the S. and W. quarters were chiefly observed, but their prevalence seemed to be universal: they all fell in nearly a vertical direction, but those in the N.W. and S.E. quarters inclined towards the S.W. The colour of the more conspicuous ones seemed to verge towards orange. Their courses were of no great length. There was at the same time a pale auroral light along the N. horizon from N.W. to N.E., apparently equally extended on each side of the true meridian. The Meteors were not watched after 7^h, but about 11^h upon looking out again I saw one, the only one in several minutes, in the S.W.; but it had no longer a vertical direction, its course pointing now to the N.W.

"For account of this phenomenon as observed by Mr. Maverly at Gosport, see 'Proceedings of the Meteorological Society during the session 1838-1839,' p. 9."

T. W. WEBB

Salmonidæ of Great Britain

IN reply to the Rev. W. S. Symonds's questions (NATURE, Vol. vii. p. 162) regarding the occurrence of certain salmonoids in Welsh and non-glacial lakes, I beg to draw his attention to the sixth volume of the "Catalogue of Fishes," published by the trustees of the British Museum, which, I believe, contains the information for which he asks. I would with pleasure extract this information for him if I were not ignorant as regards the glacial or non glacial character of some of the lakes. The geographical distribution of the various kinds of Charr is given in detail on pp. 125-154, and that of the *Coregoni* on pp. 172-199. The group of Charr and that of *Coregoni* are by no means limited to lakes, many true charr, like *Salmo*, *fluviatilis*, *fontinalis*, &c., being more or less exclusively river-fish; and *Coregonus oxyrhynchus* being common in salt water on the coasts of Holland at certain seasons of the year. In addition to Sir Philip Egerton's observation that he has taken *Salmo ferox* in Lake Bala, I may mention that the British Museum possesses an example from the Lake of Llanberis, presented by S. P. W. Ellis, Esq. (Catal. Fish, p. 93.) ALBERT GÜNTHER

British Museum, Jan. 6

M. Figuier and the Origin of American Indians

ON page 484 of Figuier's work, "The Human Race," the author speaks of the Mohawk Indians of the Rio Colorado, and on the opposite page reproduces M. Mollhausen's drawing of two Mojave Indians, as described in vol. iii. of Pacific R. R. Reports, by Messrs. Whipple, Ewbank, and Turner. As the Mohawk Indians of New York and the North-west are so totally distinct from the Colorado Mojaves, I thought it desirable to call attention to the error.

M. Figuier, I notice, in other portions of his work, finds the origin of the original peoples of America a difficult problem to solve, and I think contradicts himself. He states, on page 16, that, "unless we regard men as a solitary exception among all living beings, unless we withdraw them from the operation of the universal laws of nature, we must come to the conclusion that they do but form a certain number of races of one and the same species, and all descend from one primitive unique species." I do grant that it must have been a very unique species, whose descendants could have varied to the extent that man has. But it is not the question of variation of species that I wish to allude to, but the geography of the question. In speaking of what M. Figuier calls "the red race," pp. 404-406, he states—"The Indians cannot be accurately brought into connection with either the white, yellow, or brown race;" and again, "Probably the population which existed in the new world before the arrival of the Europeans was made up of several types different from those that are extant at present in the other regions of the globes, types having a great tendency to modify themselves, and which were obliterated whenever they came in contact with the races of Europe. But to re-ascend back to this primordial population would now be impossible." There is here a plain acknowledgment of a strictly autochthonic American people, modified since by contact with European races. This latter contact we believe, of course, to be purely imaginative; but if there was an autochthonous people in America, as the "primordial population" of Figuier is supposed to be, how then can "all (men) descend from one primitive unique species?" M. Figuier does not believe in the evolution of man from some pithecoid creature; he claims to have "shown . . . . that man is not derived . . . . from any animal." How this stand can be taken, and still the unity of the race asserted to be true, we cannot understand: for surely it cannot be denied now, that man was once lower than the lowest savage, although different from modern savages; and, as in America, there have been found traces of man's presence, as old geologically as those found in Europe; as fossil men have been found in California; and drift implements in the river gravels of the Delaware Valley, on the opposite side of the Continent; and as these implements, in part, show that their fashioners were little, if any, in advance of the beings first worthy to be called men, how could they have descended from a stock in common with the European and Asiatic races? It must have been, indeed, a unique species, whose nearest relations spread over the whole continent of North America; or starting somewhere on the Pacific coast, finally reached the Atlantic, yet made no advance—learned nothing in a slow overland journey of three thousand miles. The "primordial population," of which M. Figuier speaks, we doubt not originated in America; its pithecoid ancestry may have been European or Asiatic, but if so, the "old world" monkey was somewhat Americanised before it evolved that peculiar red-race which we call the Indians. If there ever was land communication between South America and the "old world" tropics, this pithecoid man may have reached the shores of the Southern Continent, and lost the ape-like characters after his arrival. Either evolved thus, or created *de novo*, as M. Figuier claims, the American savage is purely an American institution, and upsets that unity which M. Figuier claims for every race, tongue and condition, savage and civilised, throughout the world. CHARLES C. ABBOTT, M.D.

Trenton, New Jersey, U.S.A., Dec. 23, 1872

THE ZODIACAL LIGHT

FOR several nights lately the zodiacal light has been exceedingly bright and well-defined, and more particularly on the nights of November 24 and 27; on the evening of the 24th I found an explanation of what had often perplexed me before, viz. the existence of a faint, isolated, band of light across the zenith, but as soon as it was dark that evening, the zodiacal light was distinctly seen to stretch across the whole sky, forming that faint band of light previously observed; I then began to note its position, but the best observations were made on the night of the 27th, when it was most distinct.

On that night it passed centrally over the planet Venus, and then over the stars δ Capricorni, γ Aquarii, o Piscium, and reached a point between the Pleiades and the Hyades, so that the central portion of the light traced out the course of the Ecliptic with wonderful precision; it was brightest in the central part of the band, and gradually faded off towards the edges; its illumination about Venus was somewhat greater than that of the Milky Way, but became fainter and fainter as the light proceeded along the Ecliptic; it was impossible to trace it beyond the Hyades, where it seemed absolutely to terminate; at midnight, however, a feeble glow could be seen above the eastern horizon in Leo and Cancer, but nothing was certain about this branch.

Returning to the western and brighter branch, at Venus its breadth was about 40°, and as the longitude of the planet was 280° while that of the sun was 246°, its breadth was 40° at a distance of 34° from the sun; at δ Capricorni its breadth was 20°, at γ Aquarii 16°, and at o Piscium 10°, so that we get the following results:—

Distance from sun	Breadth
34°	40°
66	20
93	16
139	10

and its extreme distance from the sun was about 177°, where it was too faint to note anything but its existence. The light seemed perfectly fixed in the heavens, and there was no sign of any displacement such as might be caused by parallax combined with the earth's rotation; and when the brighter part had set and was far below the horizon, the band across the zenith was quite as distinct as before.

Now these few facts go a long way towards explaining the nature of the zodiacal light, and a few more observations at different times of the year may be all that are necessary to do so satisfactorily; but as the light was so vivid here, it must have been seen in other parts of the world, and a comparison of the different accounts may bring about the desired result; hence these notes, and the following rough explanation.

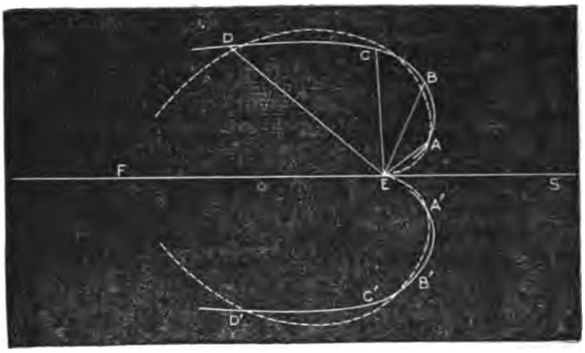
The zodiacal light has generally been supposed to be a luminous ring, surrounding the Sun, and situated between the orbits of Venus and Mars; the fact that the light has often been seen in both the east and west at the same place and time does not affect the probability of this explanation, as we have only to suppose the earth to be just within the ring; but there are many difficulties to encounter, and the explanation never seemed satisfactory. The instant, however, that I saw the prolonged ray, I felt sure that the zodiacal light was similar in its nature to the rays issued from a comet towards the sun, which, drifting over the nucleus, are then forced backwards and form the tail; and that in the case of the earth, the light is generated in those regions to which the sun is vertical, and passing round the earth, the light is swept back in a direct line from the sun, thus forming a train which always tends towards a point in the heavens 180° from the sun, and which is therefore stationary with regard to the earth's axial rotation.

It is not easy, however, to test the truth of these ideas by means of the notes above, but the following attempt may not prove uninteresting.

If the zodiacal light were a ring, and the earth within it, we could compare the distances of the different parts of the ring by means of their apparent angular breadths, supposing the actual breadth of the ring to be uniform; in order to see whether that prolonged ray was part of a ring or not, let E S be the line joining the earth and the sun, the plane of the paper coinciding with the Ecliptic; and at an angle of 34° (θ_1) measure off any length E A (r_1), in which direction the breadth of the light was 40° (ϕ_1); now, the distance r_2 of any point where the angular breadth is ϕ_2, will be determined by the equation—

$$r_2 = r_1 \tan \frac{\phi_1}{2} \cot \frac{\phi_2}{2}$$

so that we can draw E B, E C, and E D, corresponding to the second, third, and fourth observations; but the curve drawn through these points is by no means an arc of a circle, and very fairly represents what we have expressed in words above, so that the rays issuing from E towards S are swept to the right hand and to the left, and passing by the earth they form a train of light stretching out into space.



But to what an astonishing distance must this train proceed, in order to acquire an angular distance of 177° from the sun! It is, however, quite possible that the two branches close together near the point F, following the dotted curves; these curves are the positive and negative branches of the spiral of Archimedes, and fairly represent our curves for an angular distance of 90° from the sun.

MAXWELL HALL

Jamaica

THE LATE PROFESSOR W. J. MACQUORN RANKINE

THE death of Prof. Macquorn Rankine, which we announced a fortnight ago, will excite a pang in the hearts of many persons who had enjoyed actual intercourse with the genial spirit whose early loss we now mourn, and of a still greater number who were only acquainted with him through his published works. He died at his residence in Glasgow, on Christmas Eve, in his fifty-third year, the date of his birth being July 5, 1820. For several months he had been labouring under a serious derangement of his eyesight, coupled with heart disease; but it was confidently hoped for a time that his valuable life might be preserved for the benefit of science, provided that he rested himself from all his ordinary labours. Latterly he did take that rest which seemed to be so imperatively demanded by his physical nature, the chief portion of his ordinary work, namely, that of conducting his class in the University of Glasgow, being handed over to Mr. Bamber, C.E., who formerly distinguished himself as a student under the deceased professor; but the bodily system had evidently little power of resisting the ravages of the insidious disease under which it laboured; paralysis set in on Sunday, the 22nd ult., and in forty-eight hours Macquorn Rankine was dead.

The amount of space at our disposal is quite insufficient for the simple mention of the many important facts that are intimately bound up with the professional and scientific career of Professor Rankine, and therefore our sketch, at the best, can only be of the most cursory sort. In due time, doubtless, a suitable tribute will be paid to his memory and his scientific genius by the hand of one of his literary executors.

Professor Rankine was born in Edinburgh, and received most of his ordinary school education in the Burgh Academy of the town of Ayr, and in the High School of Glasgow; but he received the most valuable part of his education, doubtless, from his father, who was a retired lieutenant of the Rifle Brigade, during the residence of the family at Edinburgh. At a very early age young Rankine entered himself as a student in the University of Edinburgh, where he enjoyed the invaluable benefit of instruction in chemistry from Dr. D. B. Reid; in natural history (including zoology, geology, and mineralogy) from Prof. Jameson, a man of European reputation as a naturalist; in botany from Prof. Graham; and in natural philosophy from Prof. James D. Forbes. The extraordinary genius which he displayed in after life in pure and applied mathematics seems to have owed little or nothing to any external or adventitious aid in the shape of professional instruction: he was a born mathematician.

The bent of his mind began very early to show itself, for before he was out of his "teens" he had written two essays on purely physical subjects—"The Undulatory Theory of Light," and "Methods of Physical Investigation." When he was about eighteen years of age he betook himself to the profession of civil engineering, and served as a pupil under an eminent master, Sir John Macneil, for three or four years, a large portion of which was spent on engineering works in Ireland. He was afterwards employed for several years on railway and other engineering works in Scotland, and in 1850 or 1851 he settled down in Glasgow to pursue his profession in partnership with Mr. John Thomson, C.E.

Meanwhile, Mr. Rankine had been prosecuting inquiry in reference to several purely scientific subjects, as well as those that more immediately pertained to his profession as a civil engineer; and he did not fail to put on record the results of his investigations, almost all of which he gave to the world through the medium of one of the learned societies. He was elected a Fellow of the Royal Scottish Society of Arts in 1842, an Associate of the Institution of Civil Engineers in 1843, a Fellow of the Royal Society of Edinburgh in 1849, a Member of the Philosophical Society of Glasgow in 1853, and a Fellow of the Royal Society of London in the same year. In the year 1850 he first cast in his lot with the British Association, and at the meeting held in Edinburgh that year he was the Secretary of the Physical and Mathematical Section. He afterwards occupied still more prominent positions both in Section A and Section G, and many of his admirers looked forward with pleasure to an early meeting of the Association being held in Glasgow, when they hoped to see him filling the presidential chair.

In the year 1855 he was appointed by the Crown to the Regius Professorship of Civil Engineering and Mechanics in the University of Glasgow, in succession to Prof. Lewis Gordon, and in that highly honourable position he laboured with unexampled distinction for seventeen years. The spirit in which he conducted his class may be judged of by the following extract from the introductory lecture which he delivered on the occasion of taking possession of his chair; the subject of the lecture was, "The Harmony of Theory and Practice in Mechanics," in the course of which he said: "The objects of instruction in purely scientific mechanics and physics are, first, to produce in the student that improvement of the understanding which results from the cultivation of natural knowledge, and that elevation of mind which flows from the contemplation of the order of the universe; and, secondly, if possible, to qualify him to become a scientific discoverer. In this branch of study exactness is an essential feature, and mathematical difficulties must not be shrunk from when the nature of the subject leads to them. The ascertainment and illustration of truth are the objects; and structures and machines are looked upon merely as natural bodies are, namely, as furnishing experimental data for the ascertaining of principles and examples for their illustration."

When the British Association meeting was held in Dublin in 1857 Prof. Rankine had the honorary degree of LL.D. conferred upon him as a mark of the eminence which he had then attained as a physical investigator, although only thirty-seven years of age; and in the same year he was chosen as the first president of the Institution of Engineers in Scotland, an organisation which he materially helped to bring into existence. In November 1861 he also became President of the Philosophical Society of Glasgow, and during his term of office he conducted the business of the society with great tact and superlative ability; he delivered two addresses from the presidential chair and contributed several other papers, all of which were valuable contributions to science. We would only mention his first presidential address, the subject of which was "On the Use of Mechanical Hypotheses in Science, especially in the Theory of Heat." In it he gave a short account of the results which had been derived from that hypothesis which ascribes the mechanical action of heat to the centrifugal force of certain supposed molecular motions, a hypothesis which, like the wave theory of light, the hypothesis of atoms in chemistry, and all other physical hypotheses whatsoever, substitutes a supposed for a real phenomenon, namely, invisible motion for tangible heat; the object being to deduce the laws of the real phenomenon from those of the supposed one. Another of the most remarkable of his Philosophical Society papers was one which he read in January 1867, the subject being "On the Phrase 'Potential Energy,' and on the Definitions of Physical Quantities." This was suggested by a paper, entitled "On the Origin of Force," which Sir John Herschel contributed to the *Fortnightly Review*, and in which he expressed the opinion that the phrase in question was unfortunate, inasmuch as it went to substitute a truism for the announcement of a great dynamical fact.

Prof. Rankine did not content himself with being a "star of the first magnitude" in respect of the science of thermodynamics; he also plunged into, and won distinction in, the science of naval architecture, being impelled in that direction, doubtless, through the intimate friendly intercourse which he had with Mr. James R. Napier, F.R.S., one of the most original-minded naval architects and marine engineers that the Clyde has yet produced.

The deceased professor's writings are exceedingly numerous. He wrote and published, up to and including the year 1863, no fewer than eighty papers which were found to be worthy of mention in the Royal Society's catalogue; and between that and his death he had probably written as many more, in addition to the various treatises which he wrote upon "Civil Engineering," "Applied Mechanics," &c., all of which are of the very highest scientific and practical value. Whatever he wrote he executed with almost matchless perfection, whether we regard the elegance of his diction, the scientific order of his exposition, or the lucid methods of illustration which he adopted. His mind was of the very first order, and his death creates such a profound void in pure physics and scientific engineering that we could easily have afforded to give half-a-dozen of our most eminent practical engineers, civil or mechanical, that he might have been retained among us to pursue his original investigations and mould the minds of the engineers of the future.

JOHN MAYER

THE BIRTH OF CHEMISTRY

VI.

Latin and English MSS. on Alchemy.—Sources from which the earlier Alchemists acquired knowledge.—Arabic learning during the Middle Ages.—Geber.

IN the last article we discussed the Greek MSS. on Alchemy, and endeavoured to show that, owing to the uncertainty of their age and the obscurity of their authorship, they are less important components of the early history of chemistry than some writers have laboured to prove them.

There exist also many MSS. in Arabic and Persian on alchemy, but in all probability few of them are earlier than the 8th century. The Library of El Escorial is undoubtedly more rich in such MSS. than any existing library; but from the imperfect manner in which its treasures are catalogued, we are unable even to give a list of the more important of these treatises. The British Museum contains several Arabic MSS. on alchemy, written about the 12th century. Such of these as we have seen are devoid of drawings, and apparently also of symbols.

Early MSS. on alchemy in Latin exist in all large libraries. They contain various recipes for making the philosophers' stone, "secrets of art," copies of the inscription of the Smaragdine table, with the interpretation thereof, and an infinite amount of unintelligible nonsense. They differ in no respect from the later printed treatises on alchemy, which we shall presently discuss in detail. The matter of most of the MSS. is to be found in printed works compiled by alchemists of the 15th and 16th centuries.

One of the oldest alchemical MSS. in the British Museum is a transcript of the *Speculum Secretorum* of Roger Bacon, who died in 1284. It is in the Sloane Collection, and was written towards the end of the 13th century, say between 1290 and 1300. There is no autograph MS. of Roger Bacon either in the British Museum or in the Record Office; the MS. in question was copied by an unknown man. The following woodcut represents a few lines of the commencement of the MS.

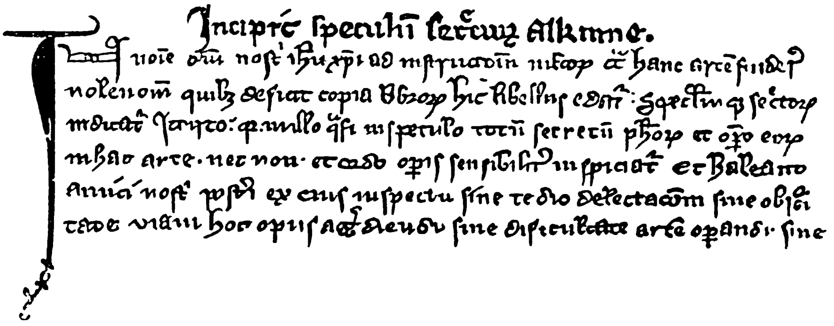


FIG. 8.—Alchemical MS. of the thirteenth century.—British Museum.

The above reads as follows:—"Incipit speculum secretorum alkimiæ. In nomine Domini Nostri Jesu Christi ad instructionem multorum circa hanc artem studere volentium, quibus deficit copia librorum, hic libellus edatur, speculumque secretorum indicatur, idcirco quia in illo, quasi in speculo, totum secretum philosophorum et operatio eorum in hac arte, nec non et ordo operis, sensibiliter inspiciatur. Et habeant amici nostri posteri ex ejus inspectu sine tedio delectationem, sine obscuritate viam hoc opus aggrediendi, sine difficultate artem operandi." The translation is as follows:—"In the name of our Lord Jesus Christ, for the information of the many who wish to devote themselves to the study of this art, and who lack a supply of books, this small manual is published, and is entitled the 'Mirror of Secrets,' seeing that in it, as in a mirror, the whole secret of philosophers and their working in this art—nay more, the process of their work—may be visibly discerned. And may our friendly descendants obtain from the perusal of it unwearied delight, a clear path for taking this work in hand, and a mode of operation unhampered by obstacles."

Among the earlier English MSS. on Alchemy in the British Museum is one which, the Preface informs us, was done "at the instance and prayer of a poure creature, and to the helping of man, I, Malmedis, being at greete uneased in prisone, have thees forseide bokes hidre to itake a hand, and so I shal fynnysshe hit, to God be the laude and preisyng."

The following woodcut (Fig. 9) represents a portion of this MS. relating to mercury[*]:—

It will be noted that mercury, together with sulphur, and the "rede stoone," is designated the producer of all metals; we also observe an allusion to the Aristotelian theory of the elements (of which an account has been given in the second of these articles) in the assertion that mercury is "hotte and moyste." This MS. is in the Sloane collection, and is well preserved, and written on vellum.

Let us now turn our attention to the dogmas of the alchemists and early chemists, as set forth in the numberless printed books on the subject.

We must bear in mind at the outset that chemistry and alchemy—understanding by the former legitimate inquiry into the nature of different kinds of matter, and by the latter the futile attempts to make gold—existed side by side in the same age, often in the same person. We cannot agree with M. Hoefer when he says, "La chimie du moyen âge, c'est l'alchimie," because some of the early chemists were not alchemists, and the crude processes of the one often led to the exact processes of the other. Lord Bacon in the "De Augmentis Scientiarum," has some very pertinent remarks regarding alchemy:—"Credulity in arts and opinions," he remarks, "is likewise of two kinds, viz., when men give too much belief to arts themselves, or to certain authors in any art. The sciences that sway the imagination more than the reason are principally three, viz., Astrology, Natural magic, and Alchemy. . . . Alchemy may be compared to the man who told his sons that he had left them gold, buried somewhere in his vineyard; where they by digging found no gold, but by turning up the mould about the roots of the vines, procured a plentiful vintage. So the search and endeavours to make gold have brought many useful inventions and instructive experiments to light."

The heritage which the alchemists and early chemists received from the ancients was by no means insignificant; for they possessed all the experience accumulated by the ancients in the various arts and processes which we have before described; and of theoretical matter they possessed, adopted, and prized, the theory of the transmutation of the elements proposed by Aristotle. Of works bearing upon the history of matter they had the writings of Aristotle, Dioscorides, Lucretius, Archimedes, Hero, Vitruvius, and Pliny. Few books are quoted more often in alchemic treatises than the "Natural History" of Pliny; and we sometimes find an almost verbatim transcript of certain portions of this work. The alchemists can therefore scarcely be said to have created a science, for the science of their day is linked with that of the ancients.

When ancient learning had almost died out, and Europe was, intellectually, in a state of complete darkness, the Arabians were the most cultivated people in the world. It is to Arabia that we must look for the origin of several sciences which we are wont to attribute to other nations. The Arabians instituted universities, observatories, public libraries, and museums; they collected together all the remains of ancient learning, and through their medium the greater number of Greek and Latin authors which were read during the Middle Ages were known to Europe.

In the eighth century the Arabs had full possession of Spain, and at a somewhat later date this country possessed the most famous universities in Europe. The Arabs, in propagating their new religion, propagated also the remains of ancient culture, which had already been introduced into Persia and Syria by the Nestorians, who had founded a school of great reputation at Odessa. Again, when Justinian closed the schools of Athens and Alexandria, many of the professors fled to Persia and Arabia, and formed new centres of learning. The works of many authors, including Aristotle, Dioscorides, and Pliny, were soon translated into Arabic and Persian, and became widely diffused. "Ce fut," remarks M. Figuier, "ainsi que de l'Inde jusqu'à l'Espagne, des rivages du Tigre jusqu'à ceux du Guadalquivir, les livres de science se propagèrent parmi des peuples qui avait déjà une littérature, une philosophie religieuse, et qui n'étaient point dépourvus d'imagination."

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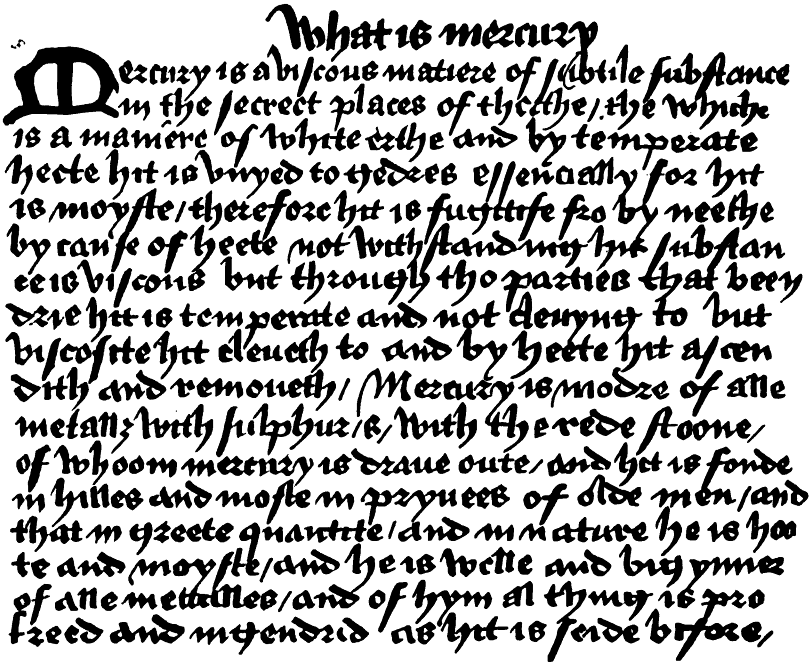
[*] We must express our great indebtedness to Mr. Maunde Thompson, of the British Museum, for allowing us ready access to the MSS. department.

In the eighth century the University of Bagdad was founded by the Caliph Al-Mansor, and in the following century it attained a pre-eminent position. A large medical school was connected with it, also hospitals and laboratories. The Caliph Al-Mamoum erected an observatory in Bagdad, and an attempt was made to measure an arc of the meridian. It is said that at one time the University of Bagdad possessed more than six thousand students. In it the sciences found a home, and every scrap of ancient learning was eagerly collected and often extended. When the Arabic empire was broken up by internal dissensions into a number of small states, the University of Bagdad, losing the powerful patronage of the Caliphs, fell into decay, and soon ceased to be known. A somewhat celebrated school arose in Cairo in the tenth century, but we possess but few particulars concerning it.



What is mercury
Mercury is a viſcous matiere of ſubtile ſubſtance
in the ſecrect places of the erthe/ the whiche
is a maniere of white erthe and by temperate
heete hit is vnyed to gedres eſſencially for hit
is moyſte/ therefore hit is fugitife fro by neethe
by cauſe of heete notwithſtanding hit ſubſtan
ce is viſcous but through tho parties that been
drie hit is temperatte and not cleuyng to but
viſcoſite hit cleueth to and by heete hit aſcen
dith and remoueth/ Mercury is modre of alle
metallz with ſulphur/ & with the rede ſtoone/
of whoom mercury is drawe oute/ and hit is fonde
in hilles and moſte in pryuees of olde men/ and
that in greete quantite/ and in nature he is hoo
te and moyſte/ and he is welle and bigynner
of alle metalles/ and of hym al thing is pro
creed and engendrid as hit is ſeide before/

FIG. 9.—English MS. on Alchemy.—Fifteenth century.

We soon hear of Spain as a focus of learning. In the tenth century this was the most flourishing country in Europe, both intellectually and otherwise. The University of Cordova possessed great celebrity, and students flocked to it from all parts of the world. It contained a library of between 200,000 and 300,000 volumes, an unusually large collection of books prior to the invention of printing. The Arabians were great mathematicians and astronomers. Lalande places Mohammed-ben-Giaber (better known as Albategnius) among the twenty greatest astronomers who have ever lived. Again, Alhazen wrote a treatise on optics in the eleventh century, and there were many treatises on botany and medicine. The Arabs made but little advance in anatomy however, because they were forbidden by the Koran to mutilate the human body.

After the above remarks it is almost needless to say that we must look to Arabia for the earliest treatises on alchemy and chemistry. Indeed the Arabians cultivated the latter science with success, and the first work on the subject with which we are acquainted was written by Yeber-Abou-Moussah-Djafer-al-Sofi, whom we call Geber, an Arab of the eighth century. There had, no doubt, been writers on chemistry before his time, but probably not long before. We have endeavoured to prove in the preceding article that the Greek MSS. on the "sacred art" are not trustworthy evidences of the early origin of the science; and we cannot tell from what source Geber acquired any of his knowledge. He alludes to no one by name, but we know that the Arabians collected knowledge from every source—Egyptian, Indian, Persian, Greek, and Roman. It is thought by some

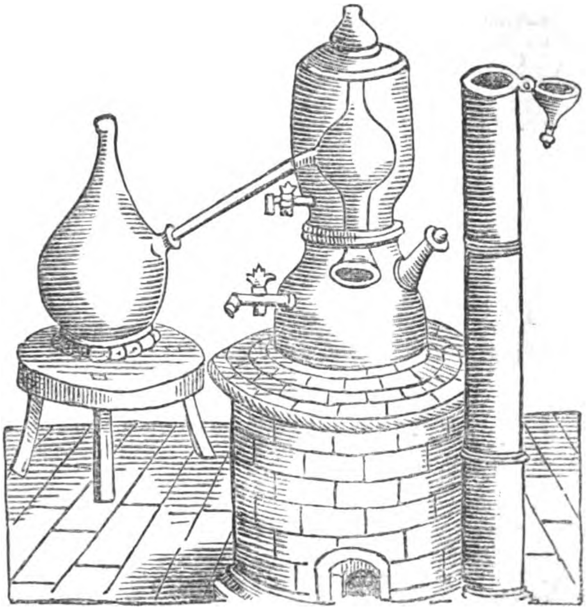


FIG. 10

that Geber acquired some of his notions of chemistry from Egypt.

Several MSS., purporting to contain the writings of Geber, exist in various libraries in Europe; these were translated into Latin as early as the year 1529, and into English in 1678. We have reason to believe that the Latin translation was faithfully done, if the Arabic text be not corrupt. The work consists of four treatises:—(α) Of the search for Perfection, (β) Of the Sum of Perfection, (γ) Of the Invention of Verity, and (δ) Of Furnaces.

Geber was acquainted with the seven metals known to the ancients, and he regarded gold, silver, copper, iron, tin, and lead, as compounds of mercury with sulphur in different proportions. Gold and silver are the most perfect metals, and are composed of the purest mercury and sulphur; the other metals consist of less pure mercury and sulphur, but may be converted into gold and silver by purifying their constituents, and uniting them in different proportions. He also describes various chemical substances, among others the following. The carbonates of potash and soda were known to Geber, and were procured from the ashes of plants. Caustic soda was procured from the carbonate by heating its solution with quicklime, as in the present day. Common salt was purified by ignition, solution, and filtration, and the solution was afterwards evaporated, and the salt crystallised out. Nitrate of potash, or saltpetre, and chloride of ammonium, or sal ammoniac, were apparently common in Geber's time; as also were alum, borax, and green copperas, or protosulphate of iron. Geber procured nitric acid by distilling copperas, saltpetre, and alum, and he used the acid for dissolving silver, and when mixed with sal ammoniac for dissolving gold. He obtained nitrate of silver in the form of crystals, and noticed their fusibility. Various compounds of mercury are described, among others corrosive sublimate or chloride of mercury, cinnabar or sulphide of mercury, and the red oxide of mercury, in which, nearly ten centuries later, oxygen gas was discovered by Dr. Priestley. Geber also obtained sulphuric acid by distilling alum. He appears to have been acquainted with the various processes of distillation, sublimation, calcination, filtration, and many others; indeed, with almost all the processes practised by his successors during the succeeding eight or nine centuries.

It is probable that some of the processes described by Geber were worked out in the medical schools of Arabia, and were known shortly before his time; yet he was himself a patient worker, and often intersperses his descriptions of substances and processes with remarks on the method of experimenting, and the mode of thought most suitable for the studies which he describes. He has often been called the "Founder of Chemistry;" at least his works are the earliest with which we are acquainted, and he was venerated as Master alike by the alchemists and chemists of the Middle Ages.

Geber appears to have been acquainted with many chemical appliances. In the earliest translations of his works we find figures of various furnaces and forms of distillatory apparatus; one of them, not unlike a still now in use, is represented above. The greater number of vessels described and figured by Baptiste Porta in his treatise *De Distillationibus*, published in 1609, are to be found in the first Latin translations of the works of Geber.

G. F. RODWELL

THE ARCTIC EXPEDITION

THE following is the text of the reply of the Government to the deputation which recently had an interview with Mr. Lowe and Mr. Goschen:—

"11, Downing Street.

"Dear Sir Henry Rawlinson,—Mr. Goschen and I have carefully considered the documents which you have laid before us with regard to the proposed Arctic Expedition.

"We do not find in them anything which shows that there is any pressing reason why the expedition should be sent this year.

"We give no opinion as to the expediency of such an expedition at a future time, but we are clearly of opinion that it would not be right to send out a second scientific expedition precisely at the moment when the public revenue has to bear the main burden of the expenses of the operations intrusted to the Challenger.

"I believe it has been erroneously stated that the Challenger Expedition involves very little expense. That is not so. The cost has already been considerable, and nothing has been spared to insure success; there will further be an additional annual outlay for three years.

"Under these circumstances, we regret that we cannot recommend the sending an exploring party to the Arctic Ocean as a Government enterprise this year.

"Believe me, yours very truly,

"(Signed) "ROBERT LOWE.

"Sir Henry C. Rawlinson, K.C.B."

It is clear, we take it from this, that it only remains for the men of science to make out their case, and we believe that the Arctic Committee are fully alive to this. The *Daily News* in a leader has indicated what we had already ventured to suggest as the weak point of the appeal, namely that it was incomplete, and that many men of science knew nothing of the proposed expedition. But in doing this we had no intention to cast a slur upon the Geographical Society; on the contrary we think that that Society's action in this matter is one which the Royal Society could now follow with the greatest advantage to science, and which we hope it will follow.

In 1865 the Geographical Society begged the Royal Society to take the lead in this matter, but the Royal Society Council declined. In 1872 the Geographical Society again entreated the Royal Society to take the matter up, but again received a chilling reply to the effect that the Royal Society Council would be prepared to give advice when applied to by the Government.

The Geographical Society then did the next best thing. It applied to other leading scientific societies, and to some few scientific men for statements of results to be derived from Arctic exploration. These it received and laid before Government, without giving any undue prominence to purely geographical results.

It is clear, therefore, that it is now the duty of the Royal Society and the other societies at once to add their influence to the movement; let a joint committee be formed to report, if need be, to the various councils. In this way the knowledge posessed by all specialists ought to be made available for the common good, so that a complete statement may be forwarded to the Government in the summer to enable the officers of the expedition to be appointed in time to avail themselves of special training.

NOTES

THE recent fusion of the Ethnological and Anthropological Societies under the designation of "the Anthropological Institute of Great Britain and Ireland," not only did good service to science but has financially proved thus far so successful that the Report of the Council for 1872, to be presented to the members next Tuesday evening at the annual meeting, announces a handsome surplus income applicable to the reduction of liabilities incurred in former years. In this promising condition of financial prosperity it is all the more to be deplored that a serious dissension has arisen in the Council in reference to the nomination of a successor to Sir John Lubbock, who, to the universal regret of the members, vacates the presidential chair, under the pressure of parliamentary and other engagements. Touching this matter we have received a copy of a printed statement signed by Mr. Harris and seven other members of Council, which alleges that at a Council Meeting, held on the 17th of last month, Dr. Charnock was placed on the House List for 1873, but that at a succeeding Council Meeting of January 7, this nomination was rescinded and the House List recast with the substitution of Professor Busk as President in the place of Dr. Charnock. This recasting of the List is made a matter of protest, and the members of the Institute, with whom the final decision rests, are appealed to. We need hardly remark that this appeal is wholly *ex parte*. We understand that the explanation given by the majority of the Council is that the vote of January 7 was a surprise, and as such justified its re-consideration. Now of all our public associations which have for their aim the advancement of scientific truth, the Anthropological can least afford to suffer by internal dissension, and it is earnestly to be hoped that this difference of opinion on the subject of a successor to Sir John Lubbock will be amicably arranged at the forthcoming meeting. The more so as it bears so clearly on the face of it that the interests of science are not in question.

A SCHEME is on foot for the establishment of a County College at Cambridge, and it seems likely to be successful. An address on the subject, with many influential signatures from among the masters, professors, and tutors of the University, has been presented to the Chancellor, the Duke of Devonshire. The County College is intended to combine and assist the efforts that are being made in the various counties of England to extend and raise the standard of middle-class education. The County College students would, as unattached students, be members of the University, but would be generally younger than the present undergraduates, and more strictly looked after. One qualification for admission would be a previous residence of two years in one or more schools accepted by the University, and the having passed the Junior Local Examination. The special branch of the college function would be to prepare teachers for the secondary schools throughout the country. The utmost expense for each student is estimated at 80*l.* per annum, with forty weeks' residence. The cost of the buildings is estimated at 20,000*l.*, which it is proposed to raise by a joint-stock company. Besides other necessary accommodation, the building will contain separate bedrooms for 300 students.

THE annual *conversazione* of the Midland Institute, which has now become one of considerable importance in Birmingham, was held on Tuesday and yesterday, and will be continued this evening, when all the exhibited objects will be thrown open to the students of the Industrial Department. The success of these meetings has considerably affected the prosperity of the Institute, which now adds the *prestige* of fashion to the more solid attractions of its educational usefulness.

WE would draw attention to the further communications on the recent star-shower which we print this week. At the moment of going to press we have received another account of the display as it was seen at Mauritius, which we hope to print next week.

PROF. HUMPHRY commenced his Lectures on Practical Anatomy, on Tuesday, January 14, at 9 A.M., and will continue them daily at the same hour till the 27th, after which they will be continued on alternate days. The course of Lectures on Anatomy and Physiology will be continued on Tuesday, January 28, at 1 P.M., and on Tuesdays, Thursdays, and Saturdays, at the same hour.

THE study of Physiological Botany receives so little attention in this country compared with what it does in France and Germany, that we are very glad to see that the editorial staff of the *Quarterly Journal of Microscopical Science* has been strengthened by the addition of the name of Prof. Thiselton Dyer to those of Mr. J. F. Payne and Mr. E. R. Lankester; an earnest, we trust, that vegetable histology will assume the place it deserves in the programme of the magazine for the future. As a commencement, Prof. McNab of Dublin contributed to the January number an article on "Haustein's Researches on the Development of the Embryo in Monocotyledons and Dicotyledons," which will, we hope, stimulate our young botanists to further research in this little-worked field.

THE Professor of Experimental Physics at Cambridge will lecture on Electrostatics and Electrokinematics during the Lent Term, in the Botanical Lecture-Room New Museum on Tuesdays, Thursdays, and Saturdays, at 12 A.M., beginning Feb. 1.

WE are indebted to the Scientific Editor of *Harper's Weekly* for the following:—Prof. Marsh and party returned on December 7 from the Rocky Mountains and Western Kansas, where they had spent the preceding two months in geological researches. They bring back a large number of vertebrate fossils from the cretaceous and tertiary formations of the West, including many new and interesting mammals, birds, and reptiles. Among the treasures secured during the present trip was a nearly entire skeleton of *Hesperornis regalis* (the gigantic diving bird of the cretaceous), numerous remains of pterodactyls, and a second species of the peculiar genus of cretaceous birds with biconcave vertebræ (*Ichthyornis*). The remains indicate a bird rather larger than *Ichthyornis dispar*, Marsh, but of more slender proportions. It may readily be distinguished from that species by the sacrum, which is proportionally more elongated, and has the cup of the posterior vertebral face more deeply concave. This species Prof. Marsh called *Ichthyornis celer*, and the group of birds now represented by the two species constitute the family of *Ichthyornidæ*.

THE work of Dr. Cowes, just published, upon the birds of the United States, includes a synopsis of the fossil forms supplied by Professor O. C. Marsh, who has made this branch of palæontology a special study. He enumerates no less than 29 species, to which number must be added several others discovered by Professor Marsh in his late trip to the Rocky Mountains. A single kind belongs to the woodpecker tribe, while two are raptorial and three gallinaceous, namely, three kinds of turkeys. Twelve are waders and eleven are swimmers.

WE are very glad to see from a report in *Les Mondes* for January 2, and from a letter sent us by the Abbé Moigno, that his most praiseworthy scheme of popular scientific lectures, instead of being likely to come to an end for want of funds, has taken a new lease of life, and that the *Salles* are now in a fair way to become a permanent Parisian institution. The Abbé and his friends have most disinterestedly spent a large sum to establish the institution, and they deserve the very highest credit and every encouragement in their attempt to provide for the Parisians the means of the best scientific and literary education; for not only are there lectures and *conversazioni* on science, art, and literature provided every night for grown-up people, but the Abbé has inaugurated a series of classes on a comprehensive plan for the higher education of the young. We sincerely hope this wide scheme will be completely successful, and that by-and-by its good effects will be markedly perceptible.

DR. T. ARCHER HIRST, V.P.R.S., F.R.A.S., President of the London Mathematical Society, and Assistant-Registrar in the University of London, is to be appointed Director of Studies in the Royal Naval College now being instituted at Greenwich.

MR. W. SAVILLE KENT has been appointed Curator of the Brighton Aquarium.

THE Octopus in the Brighton Aquarium met with a sad fate on Jan. 7. Finding himself uncomfortable in a tank where he had been newly placed by the curator, he came out, in an unguarded moment, of the house of living oysters he had collected as a shelter round him. In this tank were several large specimens of spotted dog-fish. One of these fish, with the true 'cuteness of a sea-dog, immediately pounced upon the unsuspecting octopus, and swallowed him.—Another novelty has been introduced into the Brighton Aquarium, viz., the apparatus for carrying on salmon and trout hatching. The trout from the Trent are thriving splendidly.

Apropos of the preceding, Mr. J. G. George, of Nassau, Bahamas, describes in the *American Naturalist* for December 1872, a gigantic Octopus, measuring 10 ft. long, and each arm 5 ft., the weight being estimated at between 200 and 300 pounds. The monster was found dead upon the beach and bore marks of injury. Mr. George adds that this is the first specimen he has seen during 27 years' residence in Bahamas, although they are traditionally of immense size.

M. E. Reverchon, naturalist, of Briançon, Hautes Alpes, France, offers to supply or to complete collections of the plants of Dauphiny and the south of France.

The first ordinary meeting of the new Medical Microscopical Society will take place at the Westminster Ophthalmic Hospital on the 17th inst., at 8 o'clock, when the President, Mr. Jabez Hogg, will give an introductory address.

There has just died at Paris M. Olivier Charles Camille Emmanuel, Vicomte de Rougé, Professor of Archæology in the Collége de France, and keeper of the Egyptian Museum in the Louvre, aged upwards of 61 years. He was the most eminent of French Egyptologists.

Mr. F. J. Williamson has received a commission to execute a statue of Dr. Priestley, to be erected in Birmingham. It will be 8 ft. high, and in white marble.

A Company has been recently started in Glasgow for the manufacture of asbestos into steam packing, for which purpose it has been found to exceed in durability and general usefulness every other material hitherto employed. The company, we believe, intend to put this hitherto unworkable material to a variety of other uses, it having been found, the *Glasgow Herald* says, perfectly practicable to manufacture asbestos boats, tubs, boxes, waggon bodies, and even railway carriages.

Mr. Edward Thomas, F.R.S., late of the East India Company's Bengal Civil Service, has been elected corresponding member of the French Academy, for his contributions to Oriental numismatic archæology.

Dr. G. Ischermak, Director of the Imperial museum of Mineralogy of Vienna, has published a catalogue of the meteorites in the museum up to October 1, 1872. The collection is arranged according to the system of MM. G. Rose and Rammelsberg.

We learn from the *Athenæum* that Prof. A. C. Ramsay, of the Geological Survey of the United Kingdom, has been elected Associate of the Royal Academy of Science, Belgium.

The Institution of Civil Engineers has now been in existence fifty-five years, having been established on January 2, 1818. It was incorporated by Royal Charter on June 3, 1828, and the numbers of the several classes constituting the corporation on the 1st inst., were 16 Honorary Members, 759 Members, and 1,151 Associates, with a class of Students attached of 267, together 2,193. Ten years ago there were on the books 20 Honorary Members, 413 Members, 574 Associates, and 10 Graduates, together 1,017 of all grades. The class of Graduates was abolished in the year 1867, when the class of Students was instituted.

The Government have agreed to the request of the *Daily Telegraph* to grant Mr. George Smith leave of absence for the purpose of proceeding to the East in order to make further discoveries among the Assyrian ruins. The sum placed at Mr. Smith's disposal in the meantime by the proprietors of the *Telegraph* is 1,000 guineas, and they anticipate that within six months he will be able to accomplish much. Whatever relics may be the result of the excavations, will be presented to the British Museum.

An unusually large number of Journals connected more or less intimately with science, have been started this new year. One of them is the *Irish Hospital Gazette*, intended to fill up the place left vacant by the *Dublin Hospital Gazette*, and to be especially a medium for the investigations of the physicians and surgeons of Ireland. The first number is a good one, and we hope the journal will meet with encouraging support.

According to the correspondent of the *New York Herald*, an ingenious plan has been adopted by Prof. Agassiz's expedition for determining how far the submarine regions are pervious to light. A plate prepared for photographic purposes is enclosed in a case so contrived as to be covered by a revolving lid in the space of forty minutes. The apparatus is sunk to the required depth, and at the expiration of the period stated is drawn up and developed in the ordinary way. It is said that evidence has thus been obtained of the operation of the actinic rays at much greater depths than hitherto supposed possible.

The number for January 4 of the *Revue Scientifique* contains the translation of a long and remarkably clever paper by E. von Hartmann, the purpose of which is to show that the differences between the animal and vegetable kingdoms are very much fewer than is dreamt of in the most generally accepted philosophy, that these kingdoms ought not to be classed as subordinates, but as co-ordinates, and that there is great likelihood that plants are capable in some degree of sensation and perception.

Dr. Eugene Robert, in *Les Mondes* for January 9, ascribes the disappearance of the fallen leaves of autumn to multitudes of earth-worms, which drag them into their underground galleries by means of the crooked hairy appendages with which their foremost rings are provided.

The two principal articles in the *Revue Scientifique* for January 11, are a translation of part of Prof. Tyndall's recent work on "Glaciers and the Transformations of Water," and of Mr. J. Evans' paper on "The Alphabet and its Origin."

The two principal papers in the *Moniteur Scientifique Quesneville* are "On the Respiration and the Nutrition of Vegetables," by M. Ch. Blondeau, in continuation of three previous ones, and the eighth and conclusive paper by M. Emile, "On Anthracite and its Derivatives." M. Blondeau concludes from his inquiries that vital force is essentially the same, and manifests itself in similar effects, whether it animates vegetables or animals, and regards as a popular delusion the belief that plants decompose and restore purified to the atmosphere the carbonic acid which results from animal respiration.

The first annual report of the Society of Telegraph Engineers shows that it is prosperous, and is doing good work.

We have received a second edition of "A Catalogue of the Birds of Kansas," contributed to the Kansas Academy of Science, by Mr. F. H. Snow, Professor of Natural History and Meteorology, in the University of Kansas. It contains 282 entries and seems carefully compiled.

The *Memorie della Società degli Spettroscopisti Italiani* for September contains Father Secchi's paper on the Variations of the Solar Diameter, illustrated by a carefully drawn diagram. A translation of this paper is the first article in *Der Naturforscher* for December, most of the other articles being translations from the *Comptes Rendus*, *Poggendorf's Annalen*, the *American Journal of Science*, and the published proceedings of foreign societies.

FURTHER DETAILS OF THE RECENT METEORIC SHOWER

WE have received the following further communications having reference to the recent meteoric shower. The first is an extract from a letter by Prof. Herschel:—

"Some light on the real extent and form of the radiant region will, I feel sure, be thrown as time brings fresh additions to the already great stock of information about its apparent place and features from so many observers, and from such widely distant quarters; and the knowledge so gained would be of inestimable value in clearing up the difficulties that surround the general question of the *unsettled radiation* of many meteor showers; from knowing the origin of this stream we might learn how far sporadic shooting stars may be derived from special showers of well-determined radiant points and of regularly foreseen returns. I have just received from Professors Newton and Heis in America and Germany long printed reports on their observations, which contain, I have no doubt, interesting details and speculations; but I have not yet perused them sufficiently to gather any particular idea of their contents. Capt. Tupman also wrote to me to-day, pointing out what had struck me, that the comet found by Mr. Pogson does not agree well with the contemporaneous place of the meteor-cloud through which the earth is supposed to have passed, unless its considerable distance from that place is really a proof of the extraordinary deflection of its path by the earth in its passage near it, which will make it most interesting to inquire what will become of the *new* comet in future. Two observations, which seem to be all that Mr. Pogson could obtain, are unfortunately not enough to determine its new orbit, and its 'periodic time' will therefore give us no hint as to its probable return. Capt. Tupman even suggests (to account for its '*unconformable motion*' between the first and second observation), that perhaps comet I. of the pair was seen by Mr. Pogson in his first, and comet II. of the belated Biela's couple in his second night's observations. The comet, if it is really Biela's, was, in that case at least, two months behind its time, or as Capt. Tupman says, *twelve weeks*, and it must have been 'loitering' somewhere on its path. Prof. Grant, who wrote to me to-day, says that he will send me in a few days the list of tracks of the meteors which he mapped during the shower at Glasgow, and I have no doubt that this contribution will be a very valuable addition to my 'working charts' of these strange legions.

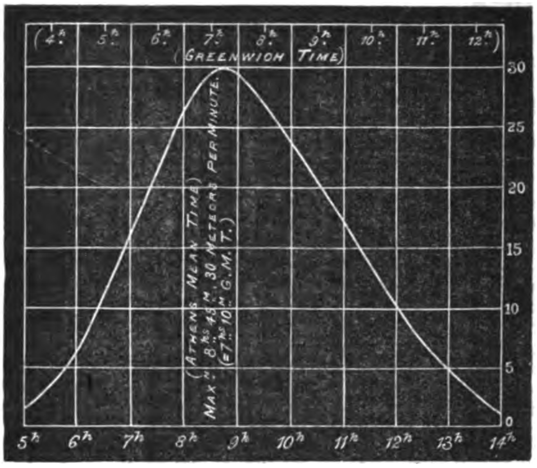
"I see that I have made a mistake in my list of 'radiant-points,' (No. 30 reading thus— 'A.D.P., Newcastle-on-Tyne,' &c. 'close to if not coincident with Mirach (γ Andromedæ).' This is a mistake, as Mirach is not γ, but β Andromedæ, and this radiant-point is therefore altogether misplaced in the list. I should like A.D.P.'s observations to be left out altogether and the observation of Mr. Van de Stadt substituted for it, thus—

No.	Observer	Place	h. m.	R.A. N.D.	Position
30	H. van de Stadt	Arnhem (Holland)	6.30 to 8.45	29 —41°	Andromeda

"The numbers in M. Denza's observations (immediately preceding it) should be changed to R. A. 29°, Decl. 41°; the R. A. and declination of the star γ Andromedæ, which I have only just now ascertained exactly.

"Prof. Heis publishes (in the Münster *Wochenschrift für Astronomie*, &c., of December 11, 18, and 25) twelve descriptions of the shower by observers at Göttingen, Dantzig, Lichtenberg, Cornorn (Hungary), Athens, &c. Those at Göttingen by Mr. Heidorn and Prof. Klinkerfues and at Athens by Dr. Schmidt are the most interesting. Prof. Klinkerfues relates that after determining the place of the radiant-point with the greatest precision at R.A. 26°, N. Decl. 37° from the projected courses of 80 meteors carefully mapped, and calculating from them the *parabolic* elements of the meteor-stream (which he gives with the radiant-point), in the usual way, he then *only accidentally* recognised its resemblance to, and evident identity with Biela while telegraphing a short note and transmitting a full account of the Göttingen observations to Dr. Heis. No wonder that at such an unexpected discovery he should have been immediately prompted to send to some observer of the southern hemisphere his famous telegram, '*Biela touched earth*, &c., look for it near θ Centauri!'

"Schmidt, at Athens, watched the shower for 9 hours uninterruptedly, from 5h. 30m. to 14h. 30m., and gives a complete curve of frequency for the whole time (in numbers for the 'four practised and two unpractised observers,' who undertook the counting) reduced to hourly numbers for a position of the radiant-point in the zenith at intervals of successive hours. On this figure I have merely altered the scale so as to exhibit his result in numbers per minute, instead of numbers per hour during the whole time. His more complete account of the shower was sent to the *Astronomische Nachrichten*, and he fixed the place of the radiant-point at R. A. 22°·5, N. Decl. 42°·5."



Curve of average frequency of Shooting Stars per minute seen by four practised observers at Athens, Nov. 27, 1872. J. F. SCHMIDT
[In Athens mean time, 1h. 35m. fast on G.M.T.]

The following has been forwarded to us by Prof. H. A. Newton:—

"Dr. Weiss, of Vienna, who first pointed out in 1868* the probable connection between Biela's comet and the meteors seen December 6, 1798, by Brandes, and December 6, 1838, by Mr. Herrick, gives the radiant for meteors following the path of that comet as R.A. 23·4°, N. Decl. 43·0°. I assigned a point 3° from γ Andromedæ as the centre of the radiant of the meteors, or about R.A. 25·3°, N. Decl. 43·3°. The longitude of the node of Biela's comet was in 1852, according to Hubbard, 245° 51′, and the comet would pass about a million of miles from the earth's orbit, between it and the sun. We passed that place of the node early Wednesday evening, November 27. There can hardly be a doubt, therefore, that these meteors were once fragments, or companions, of that comet.

"Any theory that shall explain the formation of the present grouping of meteoroids must account for the magnitude and shape of the radiant areas. If the members of a group have nearly the same orbit, the radiant should be a point. But the area of the radiant, November 24–27, was at least 8° long. This implies that the orbits differ considerably, either—(*a*) in their inclinations to the ecliptic; (*b*) in their major axes; (*c*) in the longitude of perihelion; or, in two or three of these elements combined.

"The shower ended abruptly on Wednesday evening, and in the clear evenings that followed nothing special was to be seen. Similarly marked limits are not uncommon in other showers. The orbits must then either be approximately in a plane or there must be a common node in the ecliptic, where the earth meets them. Such a node would point unequivocally to the earth as the body that originally scattered the comet.

"If, as seems more probable, the orbits, however, lie nearly in one plane, either the major axes, or the longitudes of the perihelia, must differ widely. Neither of these conditions could be satisfied, so far as I can see, by a group formed from the dispersion of a comet by Jupiter, or other large planet. If the fragments of the comet leave the neighbourhood of Jupiter, they should after each revolution return nearly to the same point in space. But a radiant area 8° or 10° long. on the night of November 27, implies a distribution of the aphelia over 10° or 12° of longitude, or a similarly large difference of major axes. Such orbits can hardly have a common point at a great distance from the sun. Moreover, a scattering accomplished in a short time upon a body moving in an orbit inclined several degrees to the ecliptic should, it would seem, be incompatible with a grouping at the earth's node.

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* Sitzungsberichte, vol. lvii.

"Again, suppose that a disrupted body or agglomeration has been once changed into a stream by the differential action of gravitation in the manner shown so beautifully by Schiaparelli. If the perturbing forces exerted by any planet or planets, whether temporary or long continued, should produce such differences of major axes, or longitudes of perihelia, by differential action, the total action would, undoubtedly, entirely scatter the group at the earth's nodes.

"In fact, instead of regarding the meteors as a stream, we ought rather to look upon the group as coming together near the perihelion—or near the node—and then scattering widely, to reassemble, perhaps, after a complete revolution in the orbit.

"A resisting medium cannot account for the observed effect, for this does not change the longitude of the perihelion of the orbit.

"It seems to me, therefore, that the periodic meteors cannot have been brought into the solar system as a stream, but that the forces which have scattered the comets are those acting near the perihelia of their orbits. As a probable corollary, we may infer that whatever force divided Biela's comet into its two principal parts was one acting near the perihelion.

"If we consider the orbits of the meteors of November 14, the preceding discussion is simplified. That shower is sharply limited, being in its greatest intensity only one or two hours long. Its recurrence at regular intervals of one-third of a century, for nearly a thousand years, precludes great differences of the major axes of the individual orbits, and the secular procession of the node of the group, *as a group*, equally forbids great differences of inclinations of the orbits.

"The size of the radiant is therefore due almost exclusively to the difference of the longitude of the perihelia. This difference for that group cannot be less than 15°.

"In conclusion I would say that we have no evidence, as yet, that any radiant of meteors is so small as is apparently required by the supposition of the distinguished Italian astronomer, that the meteors were drawn as a stream into the solar system from the stellar spaces. With Prof. Weiss and others, I am inclined to consider them all to have been once connected with periodic comets. The scattering took place apparently at or near the perihelion."

THE NATIONAL HERBARIA

THE following memorial has been transmitted to the First Lord of the Treasury on the above subject :—

"*To the Right Hon. W. E. Gladstone, First Lord of the Treasury.*

"SIR,—The undersigned persons engaged in the pursuit of botany, or in instruction therein, desire to call your serious attention to a subject that deeply concerns the progress of Natural Science, and that of those branches of agriculture, horticulture, forestry, and manufactures that largely depend on botanical research.

"The First Commissioner of Works, in a Memorandum presented to Parliament before the close of last session, clearly raised the question whether it is desirable to transfer to the branch of the British Museum about to be constructed at South Kensington the Scientific Collections and Library now existing at Kew, and further stated that, pending the decision on that subject, he considers it his duty to take care that no new expense shall be incurred at Kew which will embarrass the Ministers of the Crown or the House of Commons in arriving at a decision.

"The Lords of the Treasury, in their Minute of the 24th July, decline to refer to that portion of the above-mentioned Memorandum, and no statement on that subject has since been made by any Minister of the Crown which shows whether it has received the attention of the Government.

"Being strongly of opinion that the proposed measure would be highly detrimental to the progress of science, and injurious to all those interests that depend upon it, we beg to urge upon you that the subject is not one merely of departmental interest, and that it would not be unfitting your position, as First Minister of the Crown, to give your consideration to the following reasons which we beg to urge in opposition to the proposed measure :—

"1. That it appears to us that it is absolutely necessary that a great Botanical Garden like that at Kew, which is confessedly far the most important in the world, should be in close connection with as perfect an Herbarium and Botanical Library as possible, and that these conditions are now fulfilled as far as circumstances and the present state of science will admit.

"2. That such a combination of living and dead specimens is requisite for the complete study of plants, as regards their technical, physiological, and economic characters; and that the removal of the Herbarium would be a retrograde step in a scientific point of view.

"3. That the records of the Colonial and India Offices will show of what immense importance the establishment at Kew has been to the welfare of the entire British Empire, and that weighty questions are constantly submitted to the Director which require immediate attention, and which could not, in many cases, be satisfactorily answered without reference to the Library or Herbarium.

"4. That every facility for the investigation of the intimate structure and general habits of plants, and the study of them in every point of view which can reasonably be considered within the scope of pure Botany, is afforded by the Herbarium and Museum of Botany in connection with the Garden, and that it would be easy to point out important labours in that direction which have been instituted at Kew, while the systematic treatment has always regarded the more minute characters as well as those which are superficial.

"5. It has been remarked, indeed, that important works, such as the 'Hortus Kewensis,' have been prepared without the aid of an Herbarium at Kew. We would, however, remark that the statement is not correct, as there was an Herbarium, which was dispersed before Sir W. Hooker became Director; and the conditions of Natural Science are at the present time so completely altered that it is impossible to institute any fair comparison, the number of known species being enormously increased since the date of the publication in question.

"6. That the Museums of Structural and Economic Botany, which owe their existence and importance to the late Sir W. Hooker, are often found of great value in the decision of critical points in the study of species, and that the severance of them from the Herbarium and Library would be a serious loss.

"7. That in the principal Botanic Gardens on the Continent, where effective work is done, there is in every case a large herbarium connected with them.

"8. That, in the interest of Botanical Science, we think it highly desirable that, besides the collections now existing at Kew, an Herbarium, or collection of dried plants, as complete as possible, should be maintained in connection with the Natural History Museum which it is proposed to place at South Kensington, and that the two Herbaria should be in intimate relation with each other.

"9. That from the delicate and perishable nature of its contents, and the necessity of referring to numerous specimens, an Herbarium cannot be made use of by many persons at the same time; and while it is desirable that students should have ready means of access at the National Museum in London to collections which may enable them to identify the plants of any particular country, it is still more essential that the authors of important works in Botanical Science should be enabled, as at present, to pursue their labours at Kew without interruption from casual visitors.

"10. That an Herbarium is the least costly of all collections of Natural History, and that which requires the least amount of space for its proper maintenance, in proportion to the number of objects which it contains.

"11. That the arrangements of the Herbarium at Kew are so perfect, and the facilities for study so great, that it is resorted to from all parts of the world; and it would therefore be unwise to make a change which in the result is almost certain to be detrimental, and which, we are assured, would be especially distasteful to the leading foreign botanists.

"M. J. Berkeley, F.L.S., Botanical Director to the Royal

Horticultural Society; Charles C. Babington, F.R.S., Professor of Botany, Cambridge; M. A. Lawson, F.L.S., Professor of Botany, Oxford; J. H. Balfour, M.D., F.R.S., Professor of Botany, Edinburgh; Alexander Dixon, M.D., Professor of Botany, Glasgow; G. Dickie, M.D., F.L.S., Professor of Botany, Aberdeen; E. Perceval Wright, M.D., F.L.S., Professor of Botany, Dublin; Robert Bentley, F.L.S., Professor of Botany, King's College and Pharmaceutical Society of Great Britain; W. T. Thiselton Dyer, B.Sc., F.L.S., Professor of Botany, Royal Horticultural Society, London; R. O. Cunningham, M.D., F.L.S., Professor of Botany and Zoology, Belfast; W. R. McNab, M.D., Professor of Botany, Royal College of Science, Dublin; George Henslow, F.L.S., Lecturer at St. Bartholomew's Hospital and Royal Agricultural College, Cirencester; John Ball, F.R.S.; Maxwell T. Masters, M.D., F.R.S.; James Bateman, F.R.S.; R. Trevor Clarke, F.R.H.S.; W. Wilson Saunders, F.R.S.; Geo. F. Wilson, F.R.S.; Robert Hogg, LL.D., F.L.S., Pomological Director to the Royal Horticultural Society; W. Sowerby, F.L.S.; D. Moore, Ph.D., F.L.S.; Andrew Murray, F.L.S.; William Munro, Major-General, C.B., F.L.S.; M. Pakenham Edgeworth, F.L.S.; John Miers, F.R.S., V.P.L.S.; Frederick Currey, F.R.S., Sec. L.S.; Daniel Hanbury, F.R.S., F.L.S.; C. E. Broome, F.L.S.; Leonard Blomefield, F.L.S.; J. T. Boswell Syme, LL.D., F.L.S.; Hugh Cleghorn, M.D., F.L.S.; Clements Markham, C.B., F.L.S.; R. C. A. Prior, M.D., F.L.S.; Edward J. Waring, M.D., F.L.S.; George C. M. Birdwood, M.D.; Walter Elliot, K.C.S.I., F.L.S.; J. Forbes Watson, M.D., F.L.S.; Richard Strachey, Major-General, C.S.I., F.R.S.; E. W. Cooke, R.A. F.R.S.; Robert Braithwaite, M.D.; William Mitten, A.L.S.; W. Allport Leighton, F.L.S.; William Phillips; John Goucher, F.L.S.; J. Leicester Warren; Worthington G. Smith, F.L.S.; M. C. Cooke; James M. Crombie, F.L.S.; Alfred W. Bennett, F.L.S.; V. G. More, F.L.S.; Thomas Moore, F.L.S., Floricultural Director to the Royal Horticultural Society; Thomas Thomson, M.D., F.R.S., late Superintendent Royal Botanic Garden, Calcutta; Charles Darwin, F.R.S.; George Bentham, F.R.S.

SCIENTIFIC SERIALS

THE *Journal of Botany* for November, 1872, commences with a paper by Prof. Thiselton-Dyer, on an intricate point of vegetable histology, "Tyloses," or the cellular filling-up of vessels, with a plate. Critical botany is represented by two articles, on *Dasylirion* and *Beaucarnea*, by Mr. J. G. Baker, and notes on some Scandinavian plants, by Dr. Trimen; and geographical botany also by two—"The Influence of Insect Agency on the Distribution of Plants," by Mr. A. W. Bennett, and notes respecting some Birmingham plants, by Mr. Jas. Bagnall. Among the extracts is a very interesting one on some southern plants observed in the environs of Paris in 1871, being an account of the species added to the flora of the neighbourhood of Paris by the German invasion, amounting to 190. In the December number Dr. Trimer records and draws a recent addition to the British flora, *Psamma baltica*; and the whole of the remaining original articles relate to cryptogamic botany—the Rev. Jas. Crombie discourses on lichens, the Rev. P. O'Meara on Diatoms, Mr. J G. Baker, on a new *Asplenium* from Cape Colony, and H. Boswell, on the mosses of Oxfordshire. A large portion of the number for January, 1873, is occupied by a lengthy and interesting biography, accompanied by a portrait of the African traveller, F. Welwitsch. The remaining original articles include a contribution to the subject of the "Influence of Insect Agency on the Distribution of Plants," by Dr. Buchanan White, a valuable and suggestive paper by Prof. M'Nab, and a description by Mr. J. G. Baker of some new ferns from Lord Howe's Island. The short "Notes and Queries" are not the least interesting part of these three numbers.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 9.—"Further Remarks on the Sense of Sight in Birds," by Robert James Lee, M.A., M.D. He thinks it would be premature to enter upon general deductions until the data we possess are more numerous, and the anatomical details are generally allowed to be correct. Since his last communication he has received much assistance and valuable information from Mr. Hulke, who has directed considerable attention to the structure of the ciliary muscle in birds. In order to show the different degrees of development of the ciliary muscle, he drew up a short table containing those specimens which have been examined with most attention. For the present he considers the ciliary muscle as a simple structure for the production of one effect, whatever minute differences may exist in the internal arrangement of its fibres. According to the table the axis of vision in the Eagle Owl is 3·7; Vulture, 3·1; Buzzard, 4; *Rhea americana*, 3; Flamingo, 9; Penguin, 6; Andean Goose, 4; Vieillot's Pheasant, 6; Wood Francolin, 4·6; Canada Goose, 5; Hawk-headed Parrot, 4; Spotted Dove, 7; Grouse, 4; Partridge, 4. A second table is a continuation of that commenced in his last communication, and is intended to furnish certain data which are necessary for the determination of the visual powers in various species of birds.

"On the Union of Ammonia Nitrate with Ammonia." By Edward Divers, M.D.

Ammonia nitrate deliquesces in ammonia gas at ordinary temperatures and pressures, forming a solution of the salt in liquefied ammonia. To prepare the product, it is only requisite to pass dry ammonia gas into a flask containing the dry nitrate; but the condensation proceeds more rapidly if the flask is surrounded with ice. The liquid obtained varies in composition according to the temperature and pressure. The liquid boils when heated, and, when nearly saturated with nitrate, deposits crystals of it when cooled—just like an aqueous solution. It can also, like an aqueous solution, be heated above its boiling-point without boiling, and become supersaturated with the salt without crystallising. When poured out into an open vessel, it becomes almost instantly gelatinous in appearance—may, indeed, become so as it falls in a stream from the flask containing it. This effect is due to evaporation of ammonia and solidification of nitrate at the surface of the liquid; on breaking the crust of nitrate, the compound flows out as liquid as ever. It is not caustic to the dry skin. During its decomposition cold is manifested, and during its formation heat is evolved, but not to a great extent, because the heat given out by the liquefaction of the ammonia is nearly all used up in the liquefaction of the nitrate. Its specific gravity can be calculated from its composition, by taking for the purpose 1524·5 as the specific gravity of the nitrate, and 671 as that of the ammonia. In its rate of expansion by heat, the liquid resembles others that exist as such at ordinary temperatures, rather than those that, like ammonia itself, are only retained as such by great pressure. Its expansivity increases with the quantity of ammonia present. Its action upon a great number of substances, principally inorganic, has been tried, and found to be for the most part like that of ammonia (in the absence of water) and ammonia nitrate conjoined. The nitrate appears to undergo double decomposition with most salts, and the ammonia to unite with nearly all of them, including those of magnesium, aluminium, iron, and manganese. It is a good electrolyte, ammonia and hydrogen appearing at the negative electrode, and nitrogen and ammonia nitrate at the positive electrode.

Anthropological Institute, Jan. 7.—Sir John Lubbock, Bart., F.R.S., in the chair. A paper by the late J. W. Jackson was read on the Atlantean Race of Western Europe. The chief aim of the author was to controvert the largely accepted opinion that the dark Atlantean race was of Turanian origin.—A paper by Dr. John Shortt on the Kojahs of Southern India. The true Kojahs or Eunuchs are chiefly seen about the houses of wealthy Mussulman nobles, by whom they are placed at the head of their harems. Sometimes they hold important charges with a considerable amount of control. The ladies of the harem look upon them as their confidential advisers in all matters relating to their personal concerns. The second class of Eunuchs are called Higras or natural Eunuchs, who dress like and ape the manners of women, and are for the most part utterly worthless characters. The paper entered into minute details respecting the physical characters and habits of that strange class of men.—A joint paper by M. H. Gerber and Capt Butler on the Primordial Inhabitants of Brazil, was also read. It contained valuable and full statistical information as to the populations of the provinces; the occupations of the inhabitants, their industry and productions; the mineral wealth of the country, agriculture, manufactures, and colonisation.

Geologists' Association, Jan. 3, 1873.—The Rev. J. Wiltshire, F.R.S., president, in the chair. "On the Cambrian Rocks of Ramsey Island, St. David's;" Henry Hicks. In an exposed coast section which occurs at the north end of Ramsey Island, the three important groups of strata known under the names Lingula Flags, Tremadoc, and Arenig groups are seen resting on one another in the order of their succession, and are probably better exhibited than at any other place in Wales. The two first groups are those now usually recognised as forming the upper part of the Cambrian, and the latter as the lowest group of the Silurian system. This section is therefore at considerable importance bearing on classification, as it shows clearly the relation of the groups to each other. The Lingula Flags occur as hard siliceous sandstones with grey flaky slate, and dip under the others at an angle of about 60°. They contain the usual *Lingulella Davisii*, in great abundance; also a trilobite of the genus Nesuretus, Sophyton, a supposed land-plant, and numerous worm tracks. The beds are frequently ripple-marked, and give indications of having been shore or shallow water accumulations. The Tremadoc group rests quite comfortably on the Lingula Flags, and at first the beds are much like those of the latter in their lithological characters, but afterwards they gradually assume a darker and more flaggy appearance. Fossils are very plentiful in these beds, and numerous new forms come in. Amongst these may be mentioned the Lamellibranchs, Starfishes, and Encrinites. The tribolites belong to the genera Niobe and Nesuretus. A gentle and gradual depression of the sea-bottom was evidently taking place during the deposition of this group. Resting upon the last-mentioned is the Arenig group, a series of black, iron-stained slates and flags, and with a fauna wholly distinct from that of the Tremadoc group. The Graptolites come in here for the first time, as well as the genera Æglina, Trinucleus, and Ogygia. In many respects the fauna resemble that of the Quebec group of Canada. For the deposition of these beds a deep and decided depression of the sea-bottom must have taken place, and if the succession here is broken, this must have been sudden. It is probable, however, that a fault has passed along the strike of the beds, and that this has removed the series which should have intervened to connect them more closely, lithologically and palæontologically. As far as can be made out by the section, the boundary line between Cambrian and Silurian should certainly be placed above the Tremadoc group as exhibited at St. David's (the upper part of the Tremadoc group of North Wales will doubtless have to be included in the Arenig group) and below the Arenig group.

LEEDS

Naturalists' Field Club and Scientific Association, Dec. 10.—A paper was read by Mr. W. D. Roebuck upon the habitations constructed by hymenopterous insects, with a few remarks upon so-called parasitism, as observable among the British bees. This subject furnishes some noteworthy evidence bearing upon the question of "protective resemblance." When the bee infested by a parasite is social in its economy, and the nest is consequently never entirely deserted, the parasite assumes the colouring of its host, and is thus enabled to deceive and elude the sentries. On the other hand, if the bee attacked is of solitary habits, the female is consequently and necessarily absent when collecting her pollen and honey. This temporary absence is taken advantage of by her parasite, which does not therefore need any protection; and we accordingly find that in every case the solitary bee and her parasite are most strikingly dissimilar in appearance.

EDINBURGH

Botanical Society.—Nov. 14, 1872. The President, Prof. Wyville Thomson, delivered an address, giving biographical sketches of several of the deceased members. He then gave an address on "Fermentation and Putrefaction," which appeared in NATURE, vol. vii. p. 61. Mr. Adam Smith, Melbourne, sent a notice regarding the native bread fungus of Australia. It grows in large tubers, clusters of which are found connected together by small fibrous roots. The largest in a cluster is fully as big as a man's head, the others of smaller sizes. When cut they present the appearance of rice pudding, but although esteemed as a great delicacy by the Aborigines, they are too tasteless and insipid to become valuable for food.—Mr. John Sim noticed the occurrence of *Bupleurum rotundifolium* as a weed in a cottage garden near Perth.—Mr. Sadler exhibited specimens of a species of Lupinus, resembling *L. luteus*, which he found growing in a turnip-field near Blackshields, about 16 miles from Edinburgh, the seeds having probably been introduced with guano.

December 12.—Alexander Buchan, M.A., Vice-President, in the chair.—Mr. James M'Nab, Curator of the Royal Botanic Garden, took the chair as president, in room of Professor Wyville Thomson. "On the Organisation of Equisetums and Calamites," by William Ramsay M'Nab, M.D., Professor of Botany, Royal College of Science, Dublin. The general conclusions arrived at by the author were:—1. The stem of Equisetum differs but little in construction from that of Calamites. 2. In both Equisetums and Calamites the fibro-vascular bundles are but poorly developed. 3. The mass of tissue (woody wedges of Williamson) forming the most important part of the stem, consists of the small fibro-vascular bundles with the addition of a large quantity of thickened parenchyma and prosenchyma (sclerenchyma Mettenius). 4. The sclerenchyma (Mettenius) is part of the cortical tissues, and not a particle of the fibro-vascular bundles. 5. There is no evidence of any growth having taken place in the fibro-vascular bundles comparable to that observed in the dicotyledons. 6. If the stems of Calamites increased in diameter, it was by large additions to the cortical tissues and not to those of the fibro-vascular bundles. The President, Mr. James M'Nab, read a communication on the Disfigurement of Hedge-row Trees by telegraph wires. He thought the cropping of trees for telegraph purposes should be entrusted to some experienced gardener or forester, and not left to the mercy of men to cut and clear away as if paid by contract on the mile of clearance done.—"Notice of the occurrence in England of *Psamma baltica*, R. et Sch." By Philip Maclagan, M.D. The addition of *Psamma baltica* to the British Flora is due to Mr. William Richardson, of Alnwick. Returning one evening in August 1871 from the Holy Island towards Belford, and finding the sand wet, he betook himself to the "bents," not to botanize but to get firmer footing. He had not proceeded far when he met with the stranger growing side by side with *Psamma arenaria*. Afterwards he found it growing in patches at intervals along the coast for upwards of three miles.—Dr. John Kirk, Zanzibar, presented to the University Herbarium a collection of dried plants from the highest zone of vegetation in the Kilimanjaro, below the line of perpetual snow that crowns the summit. The Kilimanjaro is about 20,000 ft. high, in the country of Jagga, East Africa.

BOSTON, U.A.S.

American Academy of Arts and Sciences, Nov. 27, 1872.—Dr. Henry J. Bowditch alluded to a case of aortic aneurism, in which he had with the assistance of Dr. J. C. Warren, and Dr. J. J. Putnam, used electricity for the treatment of this usually fatal disease. The patient, an adult man, had a pulsation distinctly felt in the second right intercostal space, which last, with the parts adjacent, was slightly prominent, but not effaced. The respiratory murmur was free throughout both lungs, save in this part, and there it was bronchial to the extent of two or three inches; dull percussion in the same.

Two operations were made, viz. on November 12 and 17, 1872. Three needles coated with vulcanite were used at each operation. They were introduced about an inch from the first, and from an inch and a quarter to an inch and a half at the second operation. They evidently were introduced into a freely moving current at the first—as seen by the widely moving needle ends—but into a more solid mass at the second. The positive pole of the battery *alone* was applied to them, the negative resting on the right breast on a level with the tumour. The number of cells used (Stone's battery) was gradually raised from two up to sixteen at the first, and to twenty-eight at the second. The operations lasted 14½ and 14 minutes. A little faintness and pulselessness were noticed at the termination of each. They soon passed away. The result of the two operations has been a great solidity of the tumour, with considerable swelling of the parts adjacent, which swelling is now (November 26) subsiding. No superficial redness or sloughing of the skin occurred. No air appeared in the tumour, as noticed often in Europe where needles attached to both poles are usually introduced (viz. *Ciniselli Annali di Medicina*, November, 1870, Fraser's *Edin. Med. and Surg. Journal*, August 1867). The patient has suffered not at all from the operations. It is impossible as yet to say what influence they will have towards his radical cure, but he is now more comfortable than before the first operation.

December 10.—Professor E. C. Pickering exhibited a new form of theodolite magnetometer, which may be constructed at small expense from a common surveyor's transit. A mirror and magnet like that of a Thomson's galvanometer is attached to the cap of the telescope, and a right-angled prism and cross-hairs are placed in front of its eye-piece. The telescope is turned until the image of these cross-hairs is brought to coincide with those already in the eye-piece, when the axis of collimation will be exactly at right angles to the magnetic meridian. The remainder of the evening was devoted to a discussion of the great fire of November 9, by which sixty acres of the most valuable part of the city of Boston were destroyed. Numerous specimens of the effects of the fire were exhibited, among others a fused mass originally leather, but converted by the heat into a substance resembling resin. A strong wind with a velocity of twenty to twenty-five miles per hour was induced by the ascent of the heated air, although the velocity before the fire was but seven miles. This wind converted a narrow street into a sort of gigantic blow-pipe, and the flames were thus carried across Franklin Street, where it is over 100 ft. in width. The progress of the flames against the wind was noted, and explained by the radiant heat, which was so great that some of the engines were unable to get near enough to play on the fire. Buildings to windward might thus be set on fire, while those to leeward would be comparatively protected by the smoke. The carrying power of the air was remarkably great. Flakes of granite were carried across the water to South Boston, and fell in quantities on the side-walks and roofs, and papers were borne in some cases to a distance of over twenty miles. The light was so strong that it was easy to read by it in the higher parts of Belmont, over fifty miles distant; and the fire was seen at sea to a distance of ninety miles.

RIGA.

Society of Naturalists, March 6 (18 N.S.)—M. Frederking communicated a third section of his history of chemistry, in which he referred to the development of the electro-chemical hypothesis, and the discovery of isomorphism, and to that of the vegetable alkaloids.

April 3 (15 N.S.)—M. L. Taube presented a report on a work by M. Fischer, on the disease of bees, called "foul brood," which is ascribed by the author to the dying and subsequent putrescence of a portion of the larvæ. M. Fischer believes that the fluid given by the worker-bees to the larvæ is secreted by the salivary glands, and that the mortality amongst the larvæ is caused by a deficiency of this secretion brought on by a scarcity of food. He considers that this is proved by the fact that "foul-broodedness" in a hive is caused by the removal of its own workers and the substitution of healthy workers from another hive.

April 10 (22 N.S.)—M. Schroeder referred to the comet which was expected by some people to come in contact with the earth in August.—Colonel von Götschel read a paper on diseases of cage-birds, in which he especially recommended prophylactic measures.

April 24 (May 6 N.S.)—M. C. Berg criticised Sir William Thomson's opinion as to the origin of the first organisms from germs conveyed by meteorites.—M. Teich communicated a contribution to the Natural History of *Cucullia præcana*.

May 1 (13 N.S.)—A discussion took place on the means to be adopted for the protection of small birds, in which MM. Gögginger, Nauck, Westermann, and Burchardt, took part.

May 15 (27 N.S.)—M. Schroeder presented a table of the rainfall at various stations during the summer of 1871, and called attention to the very small amount recorded at Riga.

May 22 (June 3 N.S.)—Dr. Nauck communicated some observations on the torpidity of *Myoxus nitela*.—M. Westermann exhibited a pane of glass in which a circular hole of two inches diameter had been made by a hailstone on May 10. (22 N.S.) Dr. Nauck exhibited plaster-casts of hailstones from the same fall, and proposed a theory of the formation of hail by the production of a whirlwind caused by warm, moist winds meeting cold winds under angles of 90°, when the aqueous vapour is condensed, causing an inflow of air from above and below, and consequently an increase of precipitation, during which the water, striving to retain its fluid form, may easily fall several degrees below its freezing point, and its congelation into masses of ice may be accounted for by the fall into it of small grains.—M. J. H. Kawall gave an account of the publications of the Society of Naturalists of Charkow, including the titles of all the papers.

July 20 (August 1 N.S.)—The society assembled in the court of the Polytechnicum to hear an address in honour of Dr. G. Schweinfurth on his return from his African travels.

August 21 (September 2 N.S.)—Dr. Schweinfurth described several types of the inhabitants of Central Africa, belonging to the Ujam-Ujam, Bongo, Djur, Dinka, Mittu, and Akka branches of the Negro, noticing especially their modes of adorning themselves, and a few peculiar habits.—Baron F. Hoejningen-Huene communicated a continuation of his Phenological observations, containing notes on weather and other natural phenomena during the months of July and August, 1871.

PHILADELPHIA

Academy of Natural Sciences, July 2.—"On a new Genus of Extinct Turtles." Prof. Leidy stated that he had determined that the fossil-turtle he had named *Bæna undata* belonged to a different genus. Besides other well-marked distinctive characters, like the genus *Platemys*, it possessed an additional pair of plates to the usual number found in the sternum of the emydoids. These plates are intercalated between the hyo- and hypo-sternals. In *Platemys Bullockis* they are quadrate. In the new genus they are triangular, and the sutures defining them cross the plastron like a prostrated letter X, from which character it was proposed to name the genus Christernon.

July 9.—Prof. Leidy directed attention to a bottle containing numerous specimens of a minute crustacean from Salt Lake, Utah, caught on the 22nd of June by Mr. C. Carrington, a member of Prof. Hayden's exploring party now in the field. They were received from Prof. Hayden with the remark "that Salt Lake has been supposed, like the Dead Sea, to be devoid of life, but its saltest water contains the most of these little creatures." The crustacean is the *Artemia salina*, which has long been known in Europe, and has been previously found in other localities of this country. The animal has always been viewed with especial interest, in its order, from the fact that it lives and thrives best in a concentrated solution of salt, which would destroy most marine animals. It has not, I believe, been noticed in the ocean, but is found in salt lakes, and salt vats, in which, by evaporation, the brine has become more concentrated than sea water. Artemia is furnished with eleven pairs of limbs, which serve both for progression and respiration. The limbs are four-jointed, and the joints have leaf-like expansions fringed with long feather-like bristles. The narrow abdomen, or tail-like prolongation of the body is six-jointed, and traversed by the intestine. The last joint ends in a pair of processes, furnished each with a bunch of bristles like those of the limbs. The head exhibits a median, quadrate, black eye-spot, and in addition is provided with a pair of pedunculate, globular compound eyes. A short narrow pair of inarticulate antennæ project in advance of the eyes. The head of the male is furnished with a pair of singular organs for seizing the female. These claspers are large double-jointed hooks. In the female they are replaced by a pair of comparatively small horn-like processes. The first abdominal segment bears the ovarian sac in the female, and two cylindroid appendages in the male. The female of the Salt Lake Artemia ranges from four to seven lines in length; the male from three to four lines in length. The colour is translucent-white and ochreous-yellow, with three black eye-spots, and a longitudinal line varying in hue with the contents of the intestine. The ovarian sac appears orange-coloured from the eggs within. The antennæ end in three or four minute setæ, and are considerably longer in the male than the female. The first joint of the claspers is provided on its inner side just below the middle with a spheroidal knob. The last joint forms a rectangular hook, the angle having an elbow-like prominence. When the clasper is thrown forward, the outer border of the hook is convex; the anterior border straight, slightly or deeply concave, and the inner or posterior border is sigmoid. The antennæ are longer than in the female, and longer than the first joint of the claspers; and in the female are longer than their homologues. The ovarian sac is inverted flask-shaped, and has a pair of lateral conical or mamillary, finely tuberculated processes. The caudal setæ are longer than in the male, and are eight to each process. This description is taken from alcoholic specimens. They exhibit considerable variation in size, and to some extent in detail. Prof. Verrill has described what he views as two species of Artemia distinct from the well-known *A. salina*. One he names *A. gracilis*, from near Newhaven, Conn.; the other *A. Monico*, from Lake Mono, Cal. That from Salt Lake differs from either of them as much as they do from *A. salina*, and with the same propriety may be regarded as a distinct species.

I am disposed to view them all as varieties merely of *A. salina.* Prof. Leidy stated that from time to time he had observed specimens of teeth from various cretaceous formations which were identical in character with those of *Lamna elegans* and *L. cuspidata* of tertiary deposits, except that they were devoid of the lateral denticles. He had now in his possession well-preserved specimens of such teeth, unabraded, but exhibiting no trace of the existence of lateral denticles. There were teeth of the *L. elegans* variety found with the skeleton of *Hadrosaurus Foulkii* in New Jersey, and others from the cretaceous of Mississippi and Kansas. There were also teeth of the *L. cuspidata* variety from the cretaceous of Kansas, and one in a block of chalk from Sussex, England. The absence of the lateral denticles in all the cretaceous specimens he thought could hardly be accidental, and suspected that these teeth represented the *oxyrrhina* ancestors, of the tertiary *Lamna elegans* and *L. cuspidata*, which lived during the cretaceous era.

Paris

Academy of Sciences, Dec. 30, 1872.—M. Faye, president, in the chair. The president read the second portion of his paper on the solar spots. He argued in favour of their cyclonic nature, and said that the pores were simply minute spots. He pointed out that Wilson, in 1783, had suggested that the spots were "eddies and whirlpools," and that Sir J. Herschel had made use of a similar phrase, but that the knowledge only recently obtained was required before these suggestions could be accepted.—M. Jamin read a note on concealed magnetism (*magnétisme dissimulé*). The author found that when a current used to magnetise a horse-shoe bar of iron attained a certain power, the bar appeared to return to its natural state; but that, with either stronger or weaker currents, magnetism was produced. This neutral state he calls "concealed magnetism," and supposes it to be due to a particular distribution of the magnetic force.—A note from Mr. A. Cayley on the condition under which a family of surfaces forms part of an orthogonal system, was next read.—M. Janssen read the second part of his report on the eclipse of December 31. It was referred to the astronomical section.—M. F. P. Le Roux read a paper on peri-polar induction. The author applies the above name to a new form of electro-magnetic phenomena, in which the different points of the body acted on remain at the same distance from the active pole.—A paper on the dimensions of the pores of membranes by M. Guerout was presented by M. Becquerel.—M. Delafont sent a memoir on the first elements of the theory of conjugate points and right poles, which was submitted to the examination of M. Serret.—MM. Le Clère and Du Plantys sent a note on *Phylloxera* which were sent to that commission; and a second memoir on fermentation from M. Sacc was referred to a special commission.—General Doutrelaine sent a note relating to the questions of priority concerning the prolongation of the French meridian; M. Baillaud the elements and ephemerides of 127; and Mr. N. Lockyer an abstract of his late paper on spectrum analysis, communicated to the Royal Society.—MM. Troost and Hautefeuille sent a note on certain reactions of the chlorides of boron and silicon. These bodies decompose porcelain at a high temperature.—M. P. Pichard read a note on the estimation of manganese in iron ores, cast-iron, and steel, by a calorimetric process; and M. A. Houzeau, one on the volumetric estimation of minute quantities of antimony and arsenic.—M. Sorin read a note on the presence of methylamine in methylic nitrate and in methylic alcohol.—M. L. Colin's note on the passage of the blood pigment through the vascular sides in *melanemia palustris* was presented by M. Larrey, which was followed by a note on the distribution of the tympanic cord, by M. J. L. Prevost.—M. A. Béchamp read a note on the alcoholic and acetic fermentation of the liver, and on the physiological alcohol of human urine. The author has obtained from two litres of urine from a man of 50, enough alcohol to estimate.—M. A. Bernard presents a memoir on the "degeneration" of nerves after section, by M. L. Ranvier.—M. L. Posaoz sent a note on the estimation of sugar by cupric solutions. He stated that these liquids may be preserved from their usual faults by the passage of a stream of carbonic anhydride, or by the addition of alkaline bicarbonates.—M. J. Chautard sent a note on the absorption spectrum of delorophyll; and M. Sacc a note entitled, "Studies on Marmots," relating principally to the composition of the urine of these animals.—M. Decharme sent a paper on the ascending motion of liquids in very narrow vessels (bands of porous paper) compared with their ascent in capillary tubes.—M. Boileau sent a note on the preservation of potable water. The author kept eighty bottles of water fresh and free from bad odour during the siege of Paris, by leaving them simply covered with caps of paper.—M. Belgrand made some observations on this note.—M. Dausse sent a note on the best position for flood gauges in rivers.

DIARY

THURSDAY, January 16.

Royal Society, at 8.30.—Note on an Erroneous Extension of Jacobi's Theorem: J. Todhunter.—On a New Formula for a Microscopic Object-Glass: F. H. Wenham.—Additional Note to the Paper On a Supposed Alteration in the Amount of Astronomical Aberration of Light produced by the Passage of the Light through a considerable Thickness of Refracting Medium: Sir G. B. Airy.

Royal Institution, at 3.—On Oxidation: Dr. Debus.

Zoological Society, at 4.

Society of Antiquaries, at 8.30.—Election of Fellows.—Opening of Exhibition of Bronze Implements and Weapons.

Linnean Society, at 8.—On the Recent Synonyms of Brazilian Ferns: J. G. Baker

Chemical Society, at 8.—On Ethylamyl: Mr. Grimshaw—On the Heptanes from Petroleum: C. Schorlemmer—On the Vanadates of Thallium: T. Carnelley.—On the Formation of Sulphide of Sodium by the Action of Sulphuretted Hydrogen upon Sodium Chloride: C. T. Kinggeth.

Numismatic Society, at 7.

Royal Society Club, at 6.

FRIDAY, January 17.

Royal Institution, at 8.—On the Old and New Laboratories at the Royal Institution: Dr. W. Spottiswoode

Gresham Lectures, at 7.—On Contagion and Infection: Dr. E. S. Thompson.

Medical and Microscopical Society, at 8.—President's Introductory Address: Jabez Hogg.

SATURDAY, January 18.

Royal Institution, at 3.—On Comparative Politics: Dr. E. A. Freeman.

Gresham Lectures, at 7.—On Antiseptics and Disinfectants: Dr. E. S. Thompson.

MONDAY, January 20.

London Institution, at 4—On Air, Earth, Fire, and Water: Prof. Armstrong.

Society of British Architects, at 8.

Medical Society, at 8.

Asiatic Society, at 8.

Victoria Institute, at 8.

TUESDAY, January 21.

Society of Civil Engineers, at 8.

Statistical Society, at 7.45.

Anthropological Society, at 8.—Annual General Meeting.

Zoological Society, at 8.30.

WEDNESDAY, January 22.

Society of Arts, at 8

Geological Society at 8.—On the Glaciation of Ireland: J. F. Campbell.—Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders: D. Mackintosh.—On the Origin of Clay-ironstone: J. Lucas.

Royal Society of Literature, at 8.30.

Archæological Association, at 8.

London Institution, at 7.—Conversazione. The Song of Roland: Victor Pleiginer.

THURSDAY, January 23.

Royal Society, at 8.30.

Royal Society Club, at 6.

Royal Institution at 8.—On Oxidation: Dr. Debus.

Society of Antiquaries, at 8.30.—Implements of the Bronze Period: John Evans.

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THURSDAY, JANUARY 23, 1873

THE NAVY AND SCIENCE

IT would be difficult to estimate the many excellent effects that are likely to result from the establishment of the Royal Naval College, which, as has been at last authoritatively intimated, is to be opened on February 1, in those noble halls at Greenwich that for so long have been associated in another way with the British Navy. Her Majesty's Government deserve the highest praise for the wisdom—provokingly tardy though it has been—displayed in the thorough and handsome provision they have made for the scientific education of our naval officers. Much that is sarcastic, no doubt, might be said on this tardiness of a Government which seldom moves until it is driven; but as we fear this would do little good, we shall only express a hope that in future when they are compelled to take action in any matter, especially if it be scientific, they will do so as decidedly and sweepingly as they have done in the present instance.

It is usually acknowledged that the very existence of Britain as a first-rate Power depends upon the efficiency of her navy, and yet it is a lamentable fact that hitherto no nation in the world of any consequence has made less systematic provision for the training of the members of her navy than has our own. Our naval officers and seamen have been left pretty much to haphazard to gain a knowledge of their profession, and, indeed, until recently it would have been generally thought derogatory to what is vaguely known as "British pluck," had it been hinted that it would be not less plucky were it well informed; that it would have a better chance to beat all the forces in the universe, did it know the scientific principles on which a few of these forces rested. Happily this is no longer the case; the strong light of science, "the irresistible logic of facts," has shown this old knowledge to be but ignorance; and let us rejoice that this great light has at last dawned upon the magnates of our navy, and dispersed the great darkness in which they have for so long sat. The college to be opened on Feb. 1, if we may judge from the prospectus, will furnish as thorough a scientific education in the branches to be taught as can be obtained at any similar institution in any country in the world.

The immense advantages that are likely to accrue to the British Navy as such, from the excellent training which its officers must undergo at the new Naval College, are evident to all, and have been already pointed out in the columns of the general press. For one thing it will reduce the incompetents and idlers to a minimum. We are inclined to think that the gains to Science from the establishment of such an institution will be of not less importance than the increase in the efficiency of the navy which must be its special result. Our naval officers form a large, important, and influential body, having opportunities for scientific research all over the world which all students of nature must envy. Even under the old *régime* many of the most important additions to scientific knowledge in various departments were made by naval officers, some of whom have won for themselves deathless names as scientific explorers. What then must be the conquests of Science in the future when every naval officer who is capable of profiting by the instruction to be furnished at Greenwich will go forth trained and equipped to wrest from Nature some of the many secrets which she still holds in her grasp? What an immense advantage must it be to any scientific or exploring expedition when the officers that command the ship are as capable of unravelling the mysteries of Nature as they are of boxing the compass. But it would be impossible to enumerate all the advantages that we may reasonably expect to accrue to Science from the step taken by the Lords of the Admiralty. The scheme of education as it stands on paper is admirable, and most comprehensive as to subject and as to the classes for whose advantage it has been drawn out; with Rear-Admiral Kay as President of the College, and Dr. Hirst as Director of Studies, we have every reason to hope that the Royal Naval College will "become, not only an educational establishment affording the means of the highest training in theoretical subjects to naval officers of all classes, but also a nucleus of mathematical and mechanical science specially devoted to those branches of scientific investigation which have most interest for the navy."

We can only hope that the excellent example set by the Lords of the Admiralty will in a very short time be followed by the authorities of the War Office. Does not the profession of a military officer at the present day require as thorough a training to be able to fill it efficiently, as does that of a naval officer? Are not the very highest scientific principles being brought to bear on the elaboration of military weapons, and military tactics? and would not military officers, like naval officers, perform the duties of their profession more efficiently if they had a systematic training in the sciences from which modern tactics draw their life? But sad to say, the military authorities have recently shown a tendency to take the very opposite course to that which our more advanced naval authorities have so commendably followed. We hope the example of the latter will ere long shame the former into mending their ways.

The following are some of the principal points in the minute issued by the Lords of the Admiralty:—

"The College, subject to the subjoined Regulations, will be open to officers of the following ranks:—1. Captains and Commanders. 2. Lieutenants. 3. Navigating Officers. 4. Naval Instructors. 5. Acting Lieutenants and Acting Sub-Lieutenants. 6. Officers, Royal Marine Artillery; ditto, Royal Marine Light Infantry. 7. Officers of the Engineer Branch, viz.:—Chief Engineers, Engineers, 1st Class Assistant Engineers, Acting 2nd Class Assistant Engineers. 8. A limited number of Dockyard Apprentices will be annually selected, by competitive examination, for admission to the College. A course of instruction at the College will also be open to a limited number of:—9. Private students of Naval Architecture or Marine Engineering. 10. Officers of the Mercantile Marine.

"It is not intended to provide at Greenwich for the education of the Naval cadets. My Lords intend that the Royal Naval College at Greenwich shall be so organised as to provide for the education of naval officers of all ranks above that of midshipman, in all branches of theoretical and scientific study bearing upon their profession; but my Lords will continue the instruction given in the *Excellent* gunnery-ship as heretofore, and arrangements for instruction in practical surveying will also be continued at Portsmouth. My Lords desire by the establishment of the College, to give to the executive officers of the navy generally every possible advantage in respect of scientific education; but no arrangements will be made at all prejudicing the all-important practical training in the active duties of their profession. The object of securing, in the interest of the naval service, the highest possible scientific instruction is, in the opinion of my Lords, most effectually to be attained by bringing together in one establishment all the necessary means for the higher education of naval officers and of others connected with the navy. . . . Complete courses of study suitable for the different classes of students admitted will be organised, and will be carried out by professors, lecturers, and instructors. Officers and others admitted as students will have the advantage of these courses of study, whether they reside or not. But officers and others who may not become students will, under certain regulations, have free access to separate courses of lectures, the benefit of which it is desired to extend as far as possible."

The following are the proposed courses of study:—

"1. Pure Mathematics, including co-ordinate and higher Pure Geometry, Differential Calculus, Finite Differences, and the Calculus of Variations. 2. Applied Mathematics, viz., Pneumatics, Mechanics, Optics, and the Theories of Sound, Light, Heat, Electricity, and Magnetism. 3. Applied Mechanics, including the Theory of Structures, the principles of Mechanism, and the Theory of Machines. 4. Nautical Astronomy, Surveying, Hydrography, with Maritime Geography, Meteorology, and Chart Drawing. 5. Experimental Sciences:—*a.* Physics, viz., Sound, Heat, Light, Electricity, and Magnetism; *b.* Chemistry; *c.* Metallurgy. 6. Marine Engineering, in all its branches. 7. Naval Architecture, in all its branches. 8. Fortification, Military Drawing, and Naval Artillery. 9. International and Maritime Law; Law of Evidence and Naval Courts Martial. 10. Naval History and Tactics, including Naval Signals and Steam Evolutions. 11. Modern Languages. 12. Drawing. 13. Hygiene—Naval and Climatic. A certain latitude in selecting such courses of study as they may prefer will be allowed to officers voluntarily attending the College. Officers and others required to attend by the Regulations will follow such courses of study as may from time to time be prescribed.

"The general organisation of the College will be as follows:—A flag officer will be president; he will be assisted by a captain in the Royal Navy in matters affecting discipline, and in the internal arrangements of the College unconnected with study. A director of studies will, under the president, organise and superintend the whole system of instruction, and the various courses of study. There will further be—A professor of mathematics, a professor of physical science, a professor of chemistry, a professor of applied mechanics, a professor of fortification. Such instructors in mathematics and the other branches specified as may be necessary to assist the professors will be added to the staff. Lecturers will be appointed to deliver courses of lectures in naval architecture, metallurgy, civil and hydraulic engineering, maritime law, naval history and tactics, and hygiene. A naval officer will conduct instruction in nautical astronomy and surveying, and there will be two instructors in steam. Such provision will be made for instruction in French and German and in drawing, as the number of students desirous of following courses in these branches may render necessary. . . .

"Arrangements have been made for the admission of naval engineer officers to the College, which will prevent time spent at the College from entailing any pecuniary loss upon them. The School of Naval Architecture at South Kensington will be absorbed in the Royal Naval College, Greenwich. The regulations for the admission of engineer students and of dockyard apprentices have been so framed as to provide as nearly as possible the same aggregate time for their instruction as that which is now afforded at South Kensington. Further regulations will be issued by their lordships in regard to the admission of private students to the course of study at the College on similar conditions to those now existing at South Kensington. My Lords have further determined to admit a limited number of officers of the Mercantile Marine as students of the College, enjoying the full advantages of the whole course of instruction and tuition by the educational staff, while officers of the Mercantile Marine generally will, on application, be allowed to attend courses of lectures.

"The paramount object which my Lords have pursued in the organisation of the College has been to provide the most efficient means for the higher education of naval officers adequate to the constantly increasing requirements of the service; but my Lords also anticipate great advantages from the results likely to accrue from the connection which will be established through the College between men distinguished in the various departments of mathematical, physical, and chemical science, and those practical problems which so vitally interest the navigator, the naval architect, and the naval engineer. My Lords expect the College to become, not only an educational establishment affording the means of the highest training in theoretical subjects to naval officers of all classes, but also a nucleus of mathematical and mechanical science specially devoted to those branches of scientific investigation which have most interest for the navy."

ELECTROSTATICS AND MAGNETISM

Reprint of Papers on Electrostatics and Magnetism. By Sir W. Thomson, D.C.L., LL.D., F.R.S., F.R.S.E., Fellow of St. Peter's College, Cambridge, and Professor of Natural Philosophy in the University of Glasgow. (London: Macmillan and Co., 1872.)

TO obtain any adequate idea of the present state of electro-magnetic science we must study these papers of Sir W. Thomson's. It is true that a great deal of admirable work has been done, chiefly by the Germans, both in analytical calculation and in experimental researches, by methods which are independent of, or at least different from, those developed in these papers, and it is the glory of true science that all legitimate methods must lead to the same final results. But if we are to count the gain to science by the number and value of the ideas developed in the course of the inquiry, which preserve the results of former thought in a form capable of being employed in future investigation, we must place Sir W. Thomson's contributions to electro-magnetic science on the very highest level.

One of the most valuable of these truly scientific, or *science-forming* ideas, is that which forms the subject of the first paper in this collection. Two scientific problems, each of the highest order of difficulty, had hitherto been considered from quite different points of view. Cavendish and Poisson had investigated the distribution of electricity on conductors on the hypothesis that the particles of electricity exert on each other forces which vary inversely as the square of the distance between them. On the other hand Fourier had investigated the laws of the steady conduction of heat on the hypothesis that the flow of heat from the hotter parts of a body to contiguous parts which are colder is proportional to the rate at which the temperature varies from point to point of the body. The physical ideas involved in these two problems are quite different. In the one we have an attraction acting instantaneously at a distance, in the other heat creeping along from hotter to colder parts. The methods of investigation were also different. In the one the force on a given particle of electricity has to be determined as the resultant of the attraction of all the other particles. In the other we have to solve a certain partial differential equation which expresses a relation between the rates of variation of temperature in passing along lines drawn in three different directions through a point. Thomson, in this paper, points out that these two problems, so different, both in their elementary ideas and their analytical methods, are mathematically identical, and that, by a proper substitution of electrical for thermal terms in the original statement, any of Fourier's wonderful methods of solution may be applied to electrical problems. The electrician has only to substitute an electrified surface for the surface through which heat is supplied, and to translate temperature into electric potential, and he may at once take possession of all Fourier's solutions of the problem of the uniform flow of heat.

To render the results obtained in the prosecution of one branch of inquiry available to the students of another is an important service done to science, but it is still more important to introduce into a science a new set of ideas, belonging, as in this case, to what was, till then, considered an entirely unconnected science. This paper of Thomson's, published in February 1842, when he was a very young freshman at Cambridge, first introduced into mathematical science that idea of electrical action carried on by means of a continuous medium which, though it had been announced by Faraday, and used by him as the guiding idea of his researches, had never been appreciated by other men of science, and was supposed by mathematicians to be inconsistent with the laws of electrical action, as established by Coulomb, and built on by Poisson. It was Thomson who pointed out that the ideas employed by Faraday under the names of Induction, Lines of Force, &c., and implying an action transmitted from one part of a medium to another, were not only consistent with the results obtained by the mathematicians, but might be employed in a mathematical form so as to lead to new results. One of these new results, which was, we have reason to believe, obtained by this method, though demonstrated by Thomson by a very elegant adaptation of Newton's method in the theory of attraction, is the "Method of Electrical Images," leading to the "Method of Electrical Inversion."

Poisson had already, by means of Laplace's powerful method of spherical harmonies, determined, in the form of an infinite series, the distribution of electricity on a sphere acted on by an electrified system. No one, however, seems to have observed that when the external electrified system is reduced to a point, the resultant external action is equivalent to that of this point, together with an imaginary electrified point within the sphere, which Thomson calls the *electric image* of the external point.

Now if in an infinite conducting solid heat is flowing outwards uniformly from a very small spherical source, and part of this heat is absorbed at another small spherical surface, which we may call a *sink*, while the rest flows out in all directions through the infinite solid, it is easy, by Fourier's methods, to calculate the stationary temperature at any point in the solid, and to draw the isothermal surfaces. One of these surfaces is a sphere, and if, in the electrical problem, this sphere becomes a conducting surface in connection with the earth, and the external source of heat is transformed into an electrified point, the sink will become the *image* of that point, and the temperature and flow of heat at any point outside the sphere will become the electric potential and resultant force.

Thus Thomson obtained the rigorous solution of electrical problems relating to spheres by the introduction of an imaginary electrified system within the sphere. But this imaginary system itself next became the subject of examination, as the result of the transformation of the external electrified system by reciprocal *radii vectores*. By this method, called that of electrical inversion, the solution of many new problems was obtained by the transformation of problems already solved. A beautiful example of this method is suggested by Thomson in a letter to M. Liouville, dated October 8, 1845, and published in *Liouville's Journal*, for 1845, but which does not seem to have been taken up by any mathematician, till Thomson himself, in a hitherto unpublished paper (No. xv. of the book before us), wrote out the investigation complete. This, the most remarkable problem of electrostatics hitherto solved, relates to the distribution of electricity on a segment of spherical surface, or a *bowl*, as Thomson calls it, under the influence of any electrical forces. The solution includes a very important case of a flat circular dish, and of an infinite flat screen with a circular hole cut out of it.

If, however, the mathematicians were slow in making use of the physical method of electric inversion, they were more ready to appropriate the geometrical idea of inversion by reciprocal *radii vectores*, which is now well known to all geometers, having been, we suppose, discovered and re-discovered repeatedly, though, unless we are mistaken, most of these discoveries are later than 1845, the date of Thomson's paper.

But to return to physical science, we have in No. vii. a paper of even earlier date (1843), in which Thomson shows how the force acting on an electrified body can be exactly accounted for by the diminution of the atmospheric pressure on its electrified surface, this diminution being everywhere proportional to the square of the electrification per unit of area. Now this diminution of pressure is only another name for that *tension* along the lines of electric force, by means of which, in Faraday's opinion, the mutual action between electrified bodies takes place. This short paper, therefore, may be regarded as the germ of that course of speculation by which Maxwell has gradually developed the mathematical significance of Faraday's idea of the physical action of the lines of force.

We have dwelt, perhaps at too great length, on these youthful contributions to science, in order to show how early in his career, Thomson laid a solid foundation for his future labours, both in the development of mathematical theories and in the prosecution of experimental research. Mathematicians however will do well to take note of the theorem in No. xiii., the applications of which to various branches of science will furnish them, if they be diligent, both occupation and renown for some time to come.

We must now turn to the next part of this volume, in which the mathematical electrician, now established as a Professor at Glasgow, turns his attention to the practical and experimental work of his science. In such work the mathematician, if he succeeds at all, proves himself no mere mathematician, but a thoroughly furnished man of science. And first we have an account of that research into atmospheric electricity which created a demand for electrometers; then a series of electrometers of gradually improving species; and lastly, an admirable report on electrometers and electrostatic measurements, in which the results of many years' experience are given in a most instructive and scientific form. In this report the different instruments are not merely described, but classified, so that the student is furnished with the means of devising a new instrument to suit his own wants. He may also study, in the recorded history of electrometers, the principles of natural selection, the conditions of the permanence of species, the retention of rudimentary organs in manufactured articles, and the tendency to reversion to older types in the absence of scientific control.

A good deal of Sir W. Thomson's practical electrical work is not referred to in this volume. It is to be hoped that he will yet find time to give some account of his many admirable telegraphic contrivances in galvanometers, suspended coils, and recording instruments, and to complete this collection by his papers on electrolysis, measurement of resistance, electric qualities of metals, thermo-electricity, and electro-magnetism in general.

The second division of the book contains the theory of magnetism.

The first paper, communicated to the Royal Society in 1849 and 1850, is the best introduction to the theory of magnetism that we know of. The discussion of particular distributions of magnetisation is altogether original, and prepares the way for the theory of electro-magnets which follows. This paper on electro-magnets is interesting as having been in manuscript for twenty-three years, during which time a great deal has been done both at home and abroad on the same subject, but without in any degree trenching upon the ground occupied by Thomson in 1847. Though in these papers we find several formidable equations bristling with old English capitals, the reader will do well to observe that the most important results are often obtained without the use of this mathematical apparatus, and are always expressed in plain scientific English.

As regards the most interesting of all subjects, the history of the development of scientific ideas—we know of few statements so full of meaning as the note at p. 419 relating to Ampères' theory of magnetism, as depending on electric currents, flowing in circuits within the molecules of the magnet; he goes on to say:—

> "From twenty to five-and-twenty years ago, when the materials of the present compilation were worked out, I had no belief in the reality of this theory; but I did not then know that motion is the very essence of what has been hitherto called matter. At the 1847 meeting of the British Association in Oxford, I learned from Joule the dynamical theory of heat, and was forced to abandon at once many, and gradually from year to year all other, statical preconceptions regarding the ultimate causes of apparently statical phenomena."

After a short, but sufficient, proof that the magnetic rotation of the plane of polarised light discovered by Faraday implies an actual rotatory motion of something, and that this motion is part of the phenomenon of magnetism, he adds:—

> "The explanation of all phenomena of electro-magnetic attraction or repulsion, and of electro-magnetic induction, is to be looked for simply in the inertia and pressure of the matter of which the motions constitute heat. Whether this matter is or is not electricity, whether it is a continuous fluid interpermeating the spaces between molecular nuclei, or is itself molecularly grouped; or whether all matter is continuous, and molecular heterogeneousness consists in finite vortical or other relative motions of contiguous parts of a body; it is impossible to decide, and perhaps in vain to speculate, in the present state of science."

The date of these remarks is 1856. In 1861 and 1862 appeared Maxwell's "theory of molecular vortices applied to magnetism, electricity, &c." which may be considered as a development of Thomson's idea in a form which, though rough and clumsy compared with the realities of nature, may have served its turn as a provisional hypothesis.

The concluding sections of the book before us are devoted to illustrations of magnetic force derived from the motion of a perfect fluid. They are not put forward as *explanations* of magnetic force, for in fact the forces are of the opposite kind to those of magnets. They belong more properly to that remarkable extension of the science of hydrokinetics which was begun by Helmholtz and so ably followed up by Thomson himself.

The conception of a perfectly homogeneous, incompressible frictionless fluid is as essential a part of pure dynamics as that of a circle is of pure geometry. It is true that the motions of ordinary fluids are very imperfect illustrstions of those of the perfect fluid. But it is equally true that most of the objects which we are pleased to call circles are very imperfect representations of a true circle.

Neither a perfect fluid nor a perfect circle can be formed from the materials which we deal with, for they are assemblages of molecules, and therefore not homogeneous except when regarded roughly in large masses. The perfect circle is truly continuous and the perfect fluid is truly homogeneous.

It follows, however, from the investigations of Helmholtz and Thomson that if a motion of the kind called *rotational* is once set up in the fluid, the portion of the fluid to which this motion is communicated, retains for ever, during all its wanderings through the fluid mass, the character of the motion thus impressed on it.

This *vortex* then, as Helmholtz calls it, be it large or small, possesses that character of permanence and individuality which we attribute to a material molecule, while at the same time it is capable, while retaining its essential characteristics unchanged both in nature and value, of changing its form in an infinite variety of ways, and of executing the vibrations which excite those rays of the spectrum by which the species of the molecule may be discovered. It would puzzle one of the old-fashioned little round hard molecules to execute vibrations at all. There was no music in those spheres.

But besides this application of hydrokinetics to this new conception of the old atom, there is a vast field of high mathematical inquiry opened up by the papers of

Helmholtz and Thomson. It is to be hoped that the latter will soon complete his papers on *Vortex Motion* and give them to the world. But why does no one else work in the same field? Has the multiplication of symbols put a stop to the development of ideas?

OUR BOOK SHELF

Natural History Transactions of Northumberland and Durham. Vol. IV. Part II. (Williams and Norgate.)

THIS volume of upwards of 250 pages confirms the reputation already attained by the Tyneside Naturalists' Field Club, as being one of the most efficient provincial scientific societies in the kingdom. Nearly all the papers are of real and permanent value, and it is to be hoped that ere long some means will be found of bringing the work of this and similar societies before a larger public than is likely to be reached by "Transactions," which are seldom seen by any but the members or their friends. A large part of the volume is devoted to the excellently compiled Meteorological Reports for 1870 and 1871, by the Rev. R. F. Wheeler, M.A. There is here much valuable material, more interestingly and artistically put together than such reports usually are. Mr. T. J. Bold contributes a well-arranged catalogue of 151 species of *Hemiptera-Heteroptera* of Northumberland and Durham. Mr. Bold contributes besides many valuable notes on various other kinds of insects found in the district so well worked by the Tyneside society; Mr. Bold deserves the highest credit for the quantity and quality of his work. Messrs. A. Hancock and T. Atthey describe a considerable portion of a Mandibular Ramus of *Anthracosaurus Russelli* (Huxley), found in the new ironstone shale of Fenton; they also add some notes on *Loxomma Almanni* (Huxley), and on some additional remains of *Archichthys Sulcidens* (Hancock and Atthey), recently found at Newsham. The same gentlemen contribute a few remarks on *Dipterus* and *Ctenodus*, and on their relationship to *Ceratodus Forsteri* (Krefft). A well-arranged list of the non-parasitic marine *Copepoda* of the north-east coast of England is Mr. G. S. Brady's contribution to the volume. The President's address, consisting mainly of a graphic account of the numerous club excursions during 1871, is the last paper in the volume, one of the most valuable features of which is the numerous and carefully executed lithographs which are appended. Nearly every paper is illustrated. Altogether it is a thoroughly satisfactory specimen of work.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Phosphorescence in Fishes

THE only reliable observations of active phosphorescence in fishes during life, known to the writer, are the following, to which, perhaps, may be added, the somewhat obscure observations on *Hemiramphus lucens*, communicated to G. Cuvier by Reinwardt:—

1. The observations of the two Bennetts ("Whaling Voyage" and "Gatherings in Australia") on a small luminous shark (*Squalus fulgens: Isistius brasiliensis*, Q.G.). (Perhaps also observed by Giglioli.)

2. The observations of J. Bennett on the luminosity of *Scopelus stellatus* (*l.c.*).

3. The luminosity of the head of *Astronesther niger* observed by Reinhardt (Videnskab. Meddel. f.d. naturhist. Forening: Kjöbenhavn, 1853).

Very probably the faculty is widely diffused among *Scopeloids* (*sensulatiore*), and Dr. Günther may be quite right in speaking of certain enigmatical organs in the skin of these fishes as their "luminous phosphorescent organs."

In Mr. Saville Kent's very sensible remarks on the phosphorescence (erroneously ascribed to several other fishes), in vol. vii. p. 47 of NATURE, I find a statement that startled me a little, viz., that "it has been proved beyond doubt that certain fish, *Cyclopterus lumpus*, for instance, do possess highly luminous properties" (during life, of course, or Mr. S. K. would not have mentioned it at all in this connection). I think that the observations regarding *Cyclopterus lumpus*, upon which this statement is based, are unknown to other zoologists than the writer, and that they would be much obliged to Mr. S. K. for a reference to his source of information.

Z.

Movements of the Earth's Surface

IT is, I believe, commonly supposed by geologists that the movements of the surface of the earth are caused by the refrigeration and contraction of the interior. But since the glacial epoch the surface of the earth has become warmer; consequently since that time a heat wave must have been passing from the surface towards the centre; and consequently since that time no refrigeration nor contraction of the interior can have taken place. If, therefore, movements of the earth's surface were due to this cause only, no such movements should have taken place since the glacial epoch.

F. W. HUTTON

Wellington, New Zealand, Nov. 10, 1872

Meteor Observed at Mauritius

ON Nov. 7 last, about 7 o'clock. P.M., I saw the most beautiful meteor fall that I ever remember observing in my life. My face was turned in the opposite direction, but an unusually brilliant and sudden flash of light, above the brightness of the moonshine, caused me to turn suddenly round in the direction the effulgence came from, and I saw a very large meteor majestically falling through the distance, seemingly of about eight or ten yards. I am not much of an astronomer, but I think it must have fallen, apparently, from some point in Aquarius. What particularly struck me in its appearance was that it was beautifully distinct, and round as the full moon, but seemingly about the ¼th of a diameter larger. I ought, perhaps, rather to compare it to the moon at the end of her first quarter. [See p. 231 of this Number.]

A quarter of its disc only was luminous and brilliant, while the upper three-quarters emitted no luminosity, being of a dull, dusky, stone-brown colour. Here the circular outline was perfectly distinct, while the brightness of the lower limb took away all distinctness of outline there, making it appear slightly more prominent, besides throwing beyond the outline of the meteor itself a beautiful soft, steady, very bright radiance of a bluish white tint, which illuminated momentarily the whole heavens. It was observed by other people, and one person described to me having seen a similar meteor fall about this time last year, the disc appearing "about the size of a saucer," entirely luminous, but then no moon was shining.

W. WRIGHT

Moon's Surface

MAY not the white, telescopic appearance of the moon's surface, resembling snow in many parts, be explained by the fact that the extinct volcanoes of our satellite are covered with crystals of salt?

Any person who is accustomed to view the moon through a telescope must, I think, have been struck with the dazzling snow-white appearance of the mountains. May not an explanation of this be deduced from the experiences gained by the last eruption of Vesuvius?

"One of the most curious phenomena observed is the power of burning lava to retain an enormous quantity of water and salt, which it does not allow to escape till it begins to cool. . . . The formation of salt is shown generally over the whole stretch of lava emitted in 1872. Soon after the surface cools it is covered with a light crust of salt."—*See* NATURE, vol. vii. p. 2.

Is it not, therefore, probable that the numerous lava beds of the extinct volcanoes in our satellite may be coated with salt, bleached to the whiteness of snow?

C. H. W. MERLIN

British Consulate, Athens, Nov. 23

The Twinkling of the Stars

Every one who observes the stars at all must have noticed that they twinkle much more on some nights than on others, and this irrespective of any sensible difference in the clearness of sky or air. On rare occasions the twinkling becomes a really striking phenomenon, and at such times it is interesting to note the series of changes which together make up a "twinkle." For this purpose it is convenient to select two stars of suitable size and distance apart, and to look steadfastly at one, while the attention is directed to the other. The star which is not looked at will become alternately visible and invisible, and the manner in which these changes succeed each other will be found rather remarkable.

On the evening of the 1st of the present month, observing an unusual degree of twinkling, I made the above experiment on the stars ε (Epsilon) and ζ (Zeta) of Ursa Major. Looking steadily at either one of these, I noticed that the other, which was normally quite apparent, became every now and then totally invisible, and that not for an instant, but for a period of some duration. On one occasion I actually counted 30 in the interval of disappearance, and this I found afterwards to correspond to five seconds. More frequently, the star would be invisible for one or two seconds, then suddenly flash into full brilliancy, and after a variable interval vanish as suddenly again.

From this it would appear that a "twinkle," at least when strongly marked, may be resolved into a sudden accession of brightness following a more or less prolonged period of comparative obscuration.

Stars may easily be found which will show the phenomenon I have described, even more strikingly than the two above named. I once tried two of the bright stars in Orion, and in this case the apparent sudden and absolute extinction, from time to time, of a conspicuous object, produced an effect almost startling.

Clifton, Dec. 12 George F. Burder

Logarithmic Tables

The general procedure in determining numerical values in a scientific investigation is as follows. From a few observations we first compute the approximate values of certain constants, using for this purpose a theory which is purely a mathematical fiction; and then, secondly, by comparison with extended series of observations we form equations of conditions, and determine the small corrections required by the approximate values of the constants. In the first part of this work logarithms of seven or more decimal places are necessary, but in the second part, which is generally by far the most laborious, logarithms of four and five decimals can be extensively used. Hence it is important that we should have well-arranged and convenient tables of such logarithms. An objection to nearly all the small tables that I have seen is that they are encumbered with tables that are not necessary to, or which do not properly accompany a table of logarithms, such as anti-logarithms, tables of meridinal parts, &c., and the result is that the logarithmic tables are made inconvenient for use.

In the logarithmic tables recently edited by Prof. J. M. Peirce, (Ginn Brothers, Boston, 1871), the arrangement of the logarithms of numbers and of the Gaussian logarithms leaves nothing to be desired, and the method of printing the agreement in larger type is a good one. In his table of the trigonometric functions Prof. Peirce has also introduced a good idea in giving the double argument, *arc* and *time*. This arrangement of the trigonometric function is however different from the one generally given, and hence for a computer accustomed to the common table is not convenient. I think that a table of four figure logarithms, in which the logarithms of numbers and the Gaussian logarithms should be printed after the arrangement and with the excellent type and paper adopted by Prof. Peirce, and with the trigonometric functions arranged in the common order with the double argument *arc* and *time*, and which should contain *nothing else*, is a desideratum.

For tables of five decimal places I would follow the same order of arrangement, but would print the argument to the trigonometric function in arc only, and would add a small table of squares for use in least square work. Asaph Hall

Washington, Nov. 9

"Will-o'-the-Wisps"

Prof. Geikie, in his introductory lecture of the Murchison Chair of Geology at Edinburgh, which appeared in Nature, vol. vii. p. 184, mentions that he never had the good fortune to encounter one of these legendary sprites. It may not be uninteresting to some of your readers to know that they are still extant. On October 5 last I was walking to the "Lizard" with a friend, and near Ruan Major we saw a light travelling fast over the country, which my friend took to be the light of a dog-cart. As there was no road in the neighbourhood we watched, and soon saw two others rising from the same place and bounding over the country till they seemed to be about thirty feet from the ground in a swampy field opposite us, when they disappeared. Another rose from the other side of the field, and after reaching the middle of the field, it also disappeared. In about ten minutes we saw five or six, but none afterwards.

I have asked several farmers of the district and many of my friends if they had ever seen any, but have only met with one farmer who said that when a boy he used to see them on Goonhilly Downs adjoining. The geological formation of this district is serpentine. Howard Fox

Falmouth, Jan 15

Spectroscopic Observations

In corroboration of Capt. Herschel's statements regarding the mistaken idea of high dispersive power being essential to success in observations of solar prominences, I beg to give a few results obtained by a direct-vision spectroscope of dispersive power insufficient to separate D.

An object glass of 2″ diameter and 2′ 5½″ focal length (solar) was attached to this spectroscope in January last; and on the first observation—using coloured glass that absorbed rays from B to a point rather less refrangible than F—the latter line was found bright at four points on the sun's periphery, the slit being placed radial as well as tangential to the limb.

Since then I have frequently observed prominences with and without the coloured glass, and on one occasion obtained G bright. In this case the prominence, which occurred on the day preceding the binocular eclipse of June last, was a small one, but C, the line near D, and F, were all intensely vivid.

By the same spectroscope can be observed the brilliant lines of γ Argus, as also the principal lines of a large number of stars, without using a cylindrical lens.

At the red end of the spectrum I have obtained a broad belt of atmospheric absorption lines still less refrangible than the solar line that lies beyond the double atmospheric band on the red side of A.

I do not quite agree with Captain Herschel in attributing nothing to an Indian atmosphere, for the air here is doubtless more homogeneous than in the variable climes of Europe, but his protest against the prevalent notion of instruments of small dispersion being worthless for solar observations cannot be too widely circulated.

Many valuable data have probably been lost to science by observers being unaware of the power of the instruments at their disposal to work out the problems of nature.

Mangalore, Nov. 26 E. W. Pringle

GEORGE CATLIN

Mr. George Catlin, whose death we referred to last week, died in Jersey City on the 23rd of December last, after a lingering and painful illness. Mr. Catlin was born at Wilksbarre, Pennsylvania, on the 26th of July, 1796.

Mr Catlin began the series of Indian paintings which has made his name so well known everywhere, when accompanying Governor Clark, of St. Louis, in the years 1830 and 1831, while he was engaged in making treaties with several Indian tribes. In 1832 he ascended the Missouri to Fort Union, and afterward returned in a canoe with two companions, a distance of 2,000 miles, visiting and painting all the tribes, so numerous at that time on the whole length of the river. Between this and 1847 he made several extended journeys among various North American tribes, often sailing hundreds of miles in a bark canoe.

By this means he accumulated a large number of paintings representing the portraits of the principal men of the tribes, and pictures of savage life, which were exhibited by him in various parts of the United

States. He then opened his collections in London and Paris. He was occupied in their display until 1852, when he went to Venezuela, and visited the Oronoco, Amazon, and Essequibo, taking a great number of pictures on his route. He afterwards crossed the continent to Lima, and going northward visited the mouth of the Columbia River, Nootka Sound, Alaska, and Kamtschatka. From Vancouver Island he went to the Dalles, and up the Columbia River to Walla Walla, thence to the Salmon River Valley, and across the mountains into Snake River Valley at Fort Hall, thence to the Great Falls of the Snake River, and returning to Portland, proceeded to San Francisco and San Diego. From San Diego he crossed the Colorado of the West and the Rocky mountains, and descended the Rio Grande del Norte in a canoe to Matamoras.

From Matamoras he set out for Sisal, in Yucatan, and thence proceeded to Havre. Returning from that place in the fall of the same year (1855), he went to Rio Janeiro and Buenos Ayres. Ascending the Paraguay and the Parana, he crossed the "Entre Rios" mountains to the head waters of the Uruguay, which he descended to the mouth of the Rio Negro, and returned again to Buenos Ayres. From this place in 1856 he coasted the whole length of Patagonia, and then north to Panama; thence to Chagres, to Caraccas in Venezuela, to Santa Martha, and Maracaibo. It is probable that this closed his active explorations, as he soon went back to Europe, where he stayed until a year or two ago, when he returned to this country. Continually accumulating paintings in all his expeditions, their aggregate was very great, and on opening an exhibition of the greater part of them in the museum of the Smithsonian Institution in the winter of 1871 and 1872, they attracted great attention from visitors. They are now boxed up in that institution, awaiting disposal. Mr. Catlin's object in bringing them to Washington was to secure an appropriation from Congress for their purchase, this to include the remainder of his collection, which is now in Philadelphia.

The paintings of Mr. Catlin, although far from being unexceptionable as works of art, are of very great value as ethnological representations; and it is very much to be hoped that some measures may be taken to get the entire collection permanently preserved and studied. Especially in view of the fact that by far the greater number of the North American tribes included in his representations have either become exterminated or have changed their habits of life, the interest and value of Mr. Catlin's faithful portraitures may well be realised.

The first work published by Mr. Catlin was entitled, "Illustrations of the Manners, Customs, and Condition of the North American Indians, written during Eight Years of Travel and Adventure among the wildest and most remarkable Tribes now existing." This was illustrated with over three hundred steel-plate engravings from his gallery, and has long been a work of reference on subjects connected with the American aborigines, having passed through a number of editions. Some of his other works were, "North American Portfolio of Hunting Scenes," "Notes of Eight Years' Travel and Residence in Europe," "Life among the Indians," "Okeepah," "The Subsided and Uplifted Rocks of North America," &c.

ON THE OLD AND NEW LABORATORIES AT THE ROYAL INSTITUTION[*]

A TIME when, through temporary absence from one chair, and through a change of occupancy of the other, we are deprived of the presence of our two Professors, seems to offer an opportunity for reviewing the past history, the scientific results, and the future prospects of our laboratories. A time when, through circumstances which cause us much regret, we are deprived, at our evening meetings at least, of the presence of our Secretary, offers perhaps the only occasion when the task of such a review could fall to other hands than his. The fact that it has fallen to mine is attributable to the office in which your votes have placed me, rather than to any individual qualifications of my own. And it would have been impossible for me to undertake the task, had he not placed at my disposal his wide-spread information upon many branches of science, as well as his intimate knowledge of the history of the Institution, to the well-being of which his care and devotion have so largely contributed.

The first dawn of our history is to be sought among those stormy years with which the last century drew towards its close, and out of which many new thoughts and aspirations of men took their birth.

Its character, in accordance with the views of its early promoter, Count Rumford, was at first far more industrial than it eventually became. Its two great objects were "the general diffusion of the knowledge of all new and useful improvements, and teaching the application of scientific discoveries to the improvement of arts and manufactures, and to the increase of domestic comfort and convenience." The Institution was to contain models, or actual specimens of fire-places and kitchen utensils for cottages, farm-houses, and large dwellings; a complete laundry for a gentleman's family; grates and chimney pieces; brewers' boilers; distillers' coppers; ventilators; limekilns; steam-boilers; spinning wheels; agricultural implements; bridges, &c.; and at one time some eighteen or twenty young mechanics were actually boarded and lodged in the house. The records of our early proceedings give an instance, illustrating the views of the founders. In January, 1800, when the designs for the theatre, model-room, and workshops were formed, the architect proposed that the laboratory should occupy the position which it ultimately held. But, with a view to giving more room to the workshops, the proposal was set aside in the very next month, and the space in the basement under the theatre assigned to the purpose. Happily, however, before the building had reached the first floor, this position was found unsuitable; and further consideration devised the laboratory, which we have all known so well as that of Davy, of Faraday, and of Tyndall. A staircase leading to it from the front hall, although long since closed, was removed only in 1866, to make room for Prof. Tyndall's smoke chamber.

From Count Romford's final departure from England in 1802 we may date the decline of the industrial element, some echo of which still rings in our motto, "Illustrans commoda vitæ;" and early in the following year a definite proposal to give up that part of the original plan was made.

From a report to the managers in 1803, it appears that, although chemistry had always been a primary object of the Institution, yet from motives of economy nothing more had been done in the way of either laboratory or apparatus than was necessary for the immediate purpose of the lectures. It was consequently proposed that the workshop should be added to the laboratory and fitted with seats for 120 persons, and the forge adapted to chemical purposes. The report ends as follows:—"This laboratory will be equal, or indeed superior, to any in this country, and probably to any on the Continent."

The chemical laboratory was altered in accordance with that report, and remained unchanged until 1863, when, on the appointment of Dr. Frankland to the Professorship of Chemistry, the lecture seats were removed so as to adapt the room more properly to purposes of scientific research.

It is interesting to contrast the verdict of 1873 with that of 1803. "Originally built," to quote Dr. Bence Jones's own words, "as a workshop for blacksmiths, fitted with a forge, and furnished with bellows which only last summer left the Institution, our chemical laboratory was probably the very worst in London."

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[*] A lecture delivered on Friday evening last by William Spottiswoode, LL.D. Treasurer R.S. and R.I.

The physical laboratory remained unchanged; and although Professor Tyndall for himself desired nothing more than to continue his researches in a place which his imagination filled with the recollections of his predecessors, he still acquiesced in the proposal for rebuilding, for the sake of his successors, and in the interest of the sister science of his colleague.

Thus much about the material fabric of our laboratories. Next as to the scientific work of which they have been the birthplace.

Of the great names connected with this building foremost in order of time, and very high in scientific rank, stands that of Dr. Thomas Young. His "Theory of Light and Colours" will always stamp him as one "whose genius has anticipated the progress of science," and whose reputation has risen as men have better understood his worth. His first paper on the subject was presented to the Royal Society in November, 1801; but the earliest printed account of his views is to be found in his "Syllabus of Lectures at the Royal Institution," dated January 19, 1802.

With the criticisms of his theory published in the *Edinburgh Review*, with the circumstances which led to his withdrawal from the Institution, with his researches in Egyptian hieroglyphics, we are not here concerned. But it is not too much to say of him, that without the Wave Theory of Light (of which he was one of the prime and main founders) to serve as a guiding-thread through the labyrinth of phenomena, the long series of discoveries which have in this place culminated in those of Tyndall in Radiation and Absorption, would have been impossible.

It is often remarked that little rills, which have threaded their way from distant mountains, ultimately discharge themselves as mighty streams into the sea. Yet between these two stages they flow quietly, but not therefore less usefully, past smiling meadows and the haunts of men, And here is a little scientific pastoral—if it may be so called—flowing out of the highest conceptions of the theory of undulations, and furnishing, to use his own words—a simple instrument "for measuring the diameters of the fibres of different kinds of wool."* [The lecturer then described and exhibited on the screen the principle of Dr. Young's eriometer.]

Our next name is that of Davy, an account of whose discoveries would require a volume, and a bare recital of them would be long. I quote the following notes from the pen of our Secretary, and wish that he had been here to give life to the dry bones.

In 1806, when twenty-eight years of age, Davy did the work which formed his first Bakerian Lecture, "On the Chemical Agencies of Electricity." Six years previously he had written, "Galvanism I have found, by numerous experiments, to be a process purely chemical." In the interim, water had been decomposed by electricity, and Davy began his researches with an inquiry into the changes produced in water by electricity. His main conclusion was that "the kind of polarity of each element determined the electrical and chemical actions shown by it." The French Academy awarded him a medal for this work; and from these discoveries the fame of our laboratories took its rise.

The next year Davy began a new series of experiments on Polarity. He exposed different substances to the action of platinum wires coming from a battery of 100 cells; and on October 6 he wrote in his note-book, "Remarkable phenomena with potash." On the 19th he made the following entry, "A capital experiment proving the decomposition of potash." He worked at the decomposition of other alkalies until the 23rd November, when he was attacked by a fever which proved nearly fatal to him.

The importance of these decompositions to the recent science of spectral analysis, although not dreamt of at the time, can hardly be overrated; and I will therefore venture to interrupt my narrative for a moment by an experiment,—a very well-known one, which will serve to illustrate the point. [The speaker then exhibited the dark absorption line of sodium; but so arranged as to show the dark line *in the centre of*, and not entirely obliterating, the bright line; proving that a certain density of vapour is necessary for complete absorption.]

In 1808 he began to work on the composition of muriatic acid; and with a new battery provided for him by subscription, he attacked different substances with increased energy. In 1810 he sent to the Royal Society his researches on oxymuriatic acid and the elements of muriatic acid, on what is in fact now known as chlorine.

In 1811 he made the acquaintance of Mrs. Appreece, and in 1812 wrote to his brother, "In a few weeks I shall be able to return to my habits of study and research. I am going to be married to-morrow, and have a fair prospect of happiness with the most amiable and intellectual woman I have ever known." The issue of these hopes has been written by his biographers; but the disappointment of the last seventeen years of his life is illuminated by the invention, not less original in its conception than benevolent in its object, of the Safety Lamp.

The great value of this contrivance, and of questions arising out of it, will I trust, be sufficient apology for diverging again from my story in order to mention some very important experiments now in progress by Mr. Galloway. Explosions, it is well known, occur even in cases where the safety lamp is used. And it has been noticed that in these cases they occur most frequently after the firing of a blasting shot in the neighbourhood; and as it was almost certain that the penetration of the fire-damp through the gauze of the lamp was not due to a sudden flow of gas from one part of the mine to another, experiments have been instituted to determine whether the transmission of the sound wave, or wave of compression, may not have been the means of producing the mischief. Through the kindness of Mr. Galloway we have here a tube arranged for making such an experiment. At one end there is the inflammable current burning outside a safety lamp; in the centre is an elastic diaphragm, and at the other end a pistol will be fired, by the explosion of which a sound wave will be propagated along the tube. On the arrival of the sound wave at the extremity of the tube, the combustion will penetrate the safety lamp. But I here leave the matter in the hands of Mr. Galloway, of whose experiments we hope to hear more hereafter.

(*To be continued.*)

PROFESSOR TYNDALL IN AMERICA

WHAT would the readers of any of our daily papers think, if they found half-a-dozen of its columns for six days on end, filled with verbatim reports of scientific lectures? Would not they be inclined to think their paper was in its dotage? But this has been done in the case of the *New York Tribune*, in whose columns, day after day, have appeared verbatim reports, with illustrations, of the six lectures which Prof. Tyndall delivered on Light in New York during the last days of last year? Not only has this been done, but the whole series of lectures has been issued on a separate sheet of four pages, each page as large as that of any of our daily papers, with twenty illustrations somewhat rude no doubt, but quite intelligible. This valuable sheet is sold at the astounding price of three cents, and as it has not a single advertisement, it must have an immense circulation to be remunerative. Is not this one among many signs that the untrammelled Americans are rapidly outstripping us in the love for and the spread of scientific knowledge? It is certainly a noteworthy phenomenon which we wish could be witnessed nearer home. The editorial preface to the series concludes thus :—"If in the ulterior object of his (Professor Tyndall's) labours, the awakening of a spirit of scientific inquiry among our young thinkers, and the fostering of this tendency by liberal endowments from our wealthier citizens, his success shall be ultimately apparent, our whole country will have reason to thank the eminent Englishman." The following are a few passages from his concluding lecture :—

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* The King at this time had his flock of merino sheep, and Sir Joseph Banks had the care of them at Kew. On his recovery from his first mental attack the King would only call the P.R.S. his woolstapler.

"It is never to be forgotten that not one of those great investigators, from Aristotle down to Stokes and Kirchhoff, had any practical end in view, according to the ordinary definition of the word 'practical.' They did not propose to themselves money as an end, and knowledge as a means of obtaining it. For the most part, they nobly reversed this process, made knowledge of their end, and such money as they possessed the means of obtaining it. We may see to-day the issues of their work in a thousand practical forms, and this may be thought sufficient to justify it, if not ennoble their efforts. But they did not work for such issues; their reward was of a totally different kind. In what way different? We love clothes, we love food, we love fine equipages, we love money, and any man who can point to these as the results of his efforts in life justifies these efforts before all the world. In America and England more especially he is a practical man. But I would appeal confidently to this assembly whether such things exhaust the demands of human nature? Given clothes, given food, given carriages, given money—is there no pleasure beyond what these can cover which the possessor of them would still covet? The very presence here for six inclement nights of this audience, embodying, I am told, to a great extent, the mental force and refinement of this city, is an answer to my question. I need not tell such an assembly that there are joys of the intellect as well as joys of the body, or that these pleasures of the spirit constituted the reward of our great investigators. Led on by the whisperings of natural truth, through pain and self-denial, they often pursued their work. With the ruling passion strong in death, some of them, when no longer able to hold a pen, dictated to their friends the results of their labours, and then rested from them for ever. . . . That scientific discovery may put not only dollars into the pockets of individuals, but millions into the exchequers of nations, the history of science amply proves; but the hope of its doing so is not the motive power of the investigator. It never can be his motive power.

"When analysed, what are industrial America and industrial England? If you can tolerate freedom of speech on my part, I will answer this question by an illustration. Strip a strong arm, and regard the knotted muscles when the hand is clinched and the arm bent. Is this exhibition of energy the work of the muscle alone? By no means. The muscle is the channel of an influence, without which it would be as powerless as a lump of plastic dough. It is the delicate unseen nerve that unlocks the power of the muscle. And without those filaments of genius which have been shot like nerves through the body of society by the original discoverers, industrial America and industrial England would, I fear, be very much in the condition of that plastic dough. At the present time there is a cry in England for technical education, and it is the expression of a true national want; but there is no outcry for original investigation. Still without this, as surely as the stream dwindles when the spring dries, so surely will their technical education lose all force of growth, all power of reproduction. Our great investigators have given us sufficient work for a time; but if their spirit die out, we shall find ourselves eventually in the condition of those Chinese mentioned by De Tocqueville, who, having forgotten the scientific origin of what they did, were at length compelled to copy without variation the inventions of an ancestry who, wiser than themselves, had drawn their inspiration direct from Nature.

"To keep society as regards science in healthy play, three classes of workers are necessary: Firstly, the investigator of natural truth, whose vocation it is to pursue that truth, and extend the field of discovery for the truth's own sake, and without any reference to practical ends. Secondly, the teacher of natural truth, whose vocation it is to give public diffusion to the knowledge already won by the discoverer. Thirdly, the applier of natural truth, whose vocation it is to make scientific knowledge available for the needs, comforts, and luxuries of life. These three classes ought to coexist, and interact upon each other. Now, the popular notion of science, both in this country and in England, often relates, not to science strictly so called, but to the applications of science. Such applications, especially on this continent, are so astounding—they spread themselves so largely and umbrageously before the public eye—as to shut out from view those workers who are engaged in the profounder business of discovery."

After quoting De Tocqueville on the supposed unfavourable influence which republicanism has on the advance of science, Prof. Tyndall says :—

"It rests with you to prove whether these things are necessarily so, whether the highest scientific genius cannot find in the midst of you a tranquil home. I should be loth to gainsay so keen an observer and so profound a critical writer, but, since my arrival in this country, I have been unable to see anything in the constitution of society to prevent any student with the root of the matter in him from bestowing the most steadfast devotion on pure science. If great scientific results are not achieved in America, it is not to the small agitations of society that I should be disposed to ascribe the defect, but to the fact that men among you who possess the genius for scientific inquiry are laden with duties of administration or tuition so heavy as to be utterly incompatible with the continuous or tranquil meditation which original investigation demands. I do not think this state of things likely to last. I have seen in America willingness on the part of individuals to devote their fortunes in the matter of education to the service of the commonwealth, for which I cannot find a parallel elsewhere.

"This willingness of private men to devote fortunes to public purposes requires but wise direction to enable you to render null and void the prediction of De Tocqueville. Your most difficult problem will be not to build institutions, but to make men; not to form the body, but to find the spiritual embers which shall kindle within that body a living soul. You have scientific genius among you; not sown broadcast, believe me, but still scattered here and there. Take all unnecessary impediments out of its way. You have asked me to give these lectures, and I cannot turn them to better account than by asking you in turn to remember that the lecturer is usually the distributor of intellectual wealth amassed by better men. It is not as lecturers, but as discoverers, that you ought to employ your highest men. Keep your sympathetic eye upon the originator of knowledge. Give him the freedom necessary for his researches, not overloading him either with the duties of tuition or of administration, not demanding from him so-called practical results—above all things, avoiding that question which ignorance so often addresses to genius: 'What is the use of your work?' Let him make truth his object, however impracticable for the time being, that truth may appear. If you cast your bread thus upon the waters, then be assured it will return to you, though it may be after many days."

ON THE SPECTROSCOPE AND ITS APPLICATIONS

III.

So far, I have spoken of spectroscopes as spectroscopes—as one of the instruments the improvement of which should be cared for by every student in science. Their applications will come after. As may be imagined, spectroscopes are now constructed with one, two, three, four, or more prisms, the number depending on the purpose for which they are to be employed. An instrument with one prism is usually called a chemical spectroscope, for an instrument of this kind is now almost as important and essential in a chemical laboratory as a balance. Spectroscopes are also constructed with two prisms, as shown in Fig. 13; these are used in cases when rather more dispersion is desired than can be obtained with the one-prism instrument. When, however, any accurate and elaborate work has to be done, such as in carrying out original investigations, more prisms have to be employed. The engraving given in Fig. 14 is of an instrument which historically is extremely interesting, as being the one with which Kirchhoff made his most elaborate and accurate maps of the solar spectrum; it is furnished with a battery of four large prisms, which give an enormous deviation and dispersion. There is no reason why spectroscopes of many more prisms should not be employed, except that they require to be worked only with strong lights, as light is here so much dispersed or spread out that a feeble spectrum would be almost lost. As the principle of construction is almost the same in all kinds of spectroscopes, we had better commence by a description of the simplest form, namely, that with one prism, as shown in Fig. 15. It will be seen to consist of a circular table, supported by a pillar and three legs, carrying three lateral tubes; the right-hand tube is called the collimator, and holds at its outer extremity the fine slit, the width of which can be regulated to a nicety by a micrometer screw; the other end of the collimator is furnished with a lens, which serves to collect the rays of light coming from the slit, and to render them parallel before falling on the prism in the centre of the table. The prism is so placed and fixed by a clamp that the light entering the slit from the source of light, shown in the figure as a gas lamp, strikes it and leaves it at what is called the *angle of minimum deviation*, a term which has already been explained; after passing through the prism, in which the light undergoes both deviation and dis-

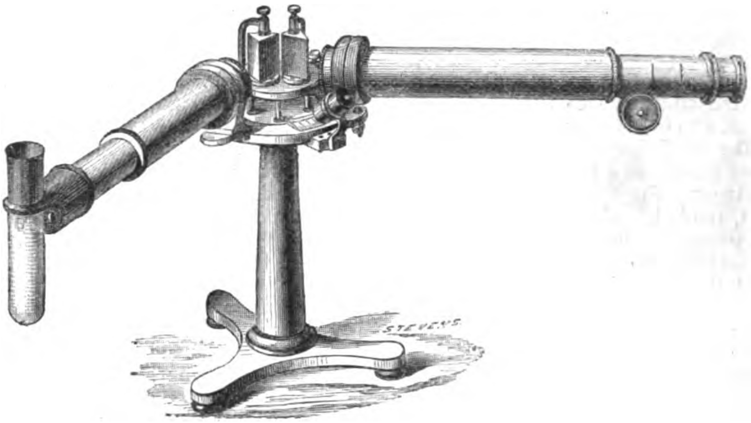

FIG. 13.—Spectroscope with two prisms.

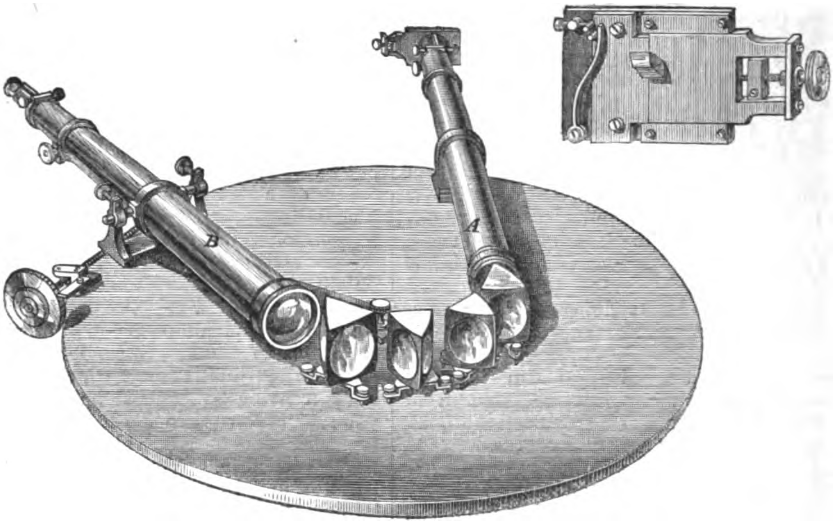

FIG. 14.—Steinheil's form of four-prism spectroscope; arrangement of slit shown separately.

persion, the spectrum is observed by the telescope on the left, which is simply a small astronomical telescope of low magnifying power. There are two methods of measuring spectra. The telescope may be attached to a moveable arm, which can be directed to any part of the spectrum that may be required; and the outer edge of the circle along which the telescope moves may be graduated with an accurate scale of degrees, which can be divided with more or less minuteness, according to the precision in the exact position of the dark lines, &c., in various spectra required. In this method the line to be measured is brought into the centre of the field of view of the observing telescope, and the position of the telescope read off. Of course if the line measured is situated in the red end of the spectrum, the telescope will be in a different position to that it will occupy if the line be in the blue end. The second method of measurement may be gathered from Fig. 15. It consists of a short tube carrying at its outer extremity a small photographic scale, which is illuminated by a candle flame; the light passing from the photographic scale is rendered parallel and thrown on the surface of the prism by means of a lens in the tube carrying the scale, and is reflected by the last surface of the prism up the observing telescope, so that it is seen as a bright scale on the background, formed by the spectrum under observation.

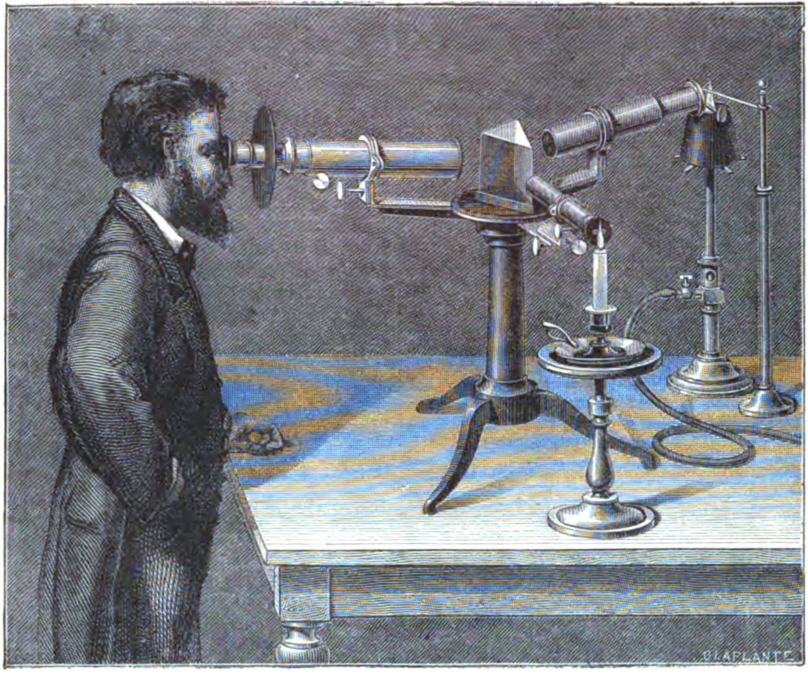

FIG. 15.—Spectroscope with reflected scale.

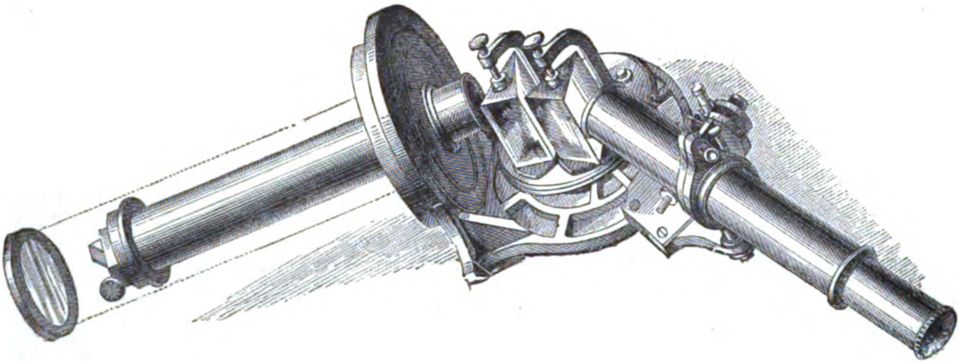

FIG. 16.—Huggins' star spectroscope.

The spectroscope has also been adapted to the telescope with very great success; for it is essential not only to determine the spectra of the light emitted by various substances in our laboratories on this earth, but also the different spectra and positions of the dark lines or bright ones, &c., obtained from the various orders of celestial objects, such as the sun and stars, comets, nebulæ, planets, and so on; we must for this purpose have something attached to the telescope. Fig. 16 shows a star spectroscope, which differs in arrangement only and not in principle from other spectroscopes, except in one point to which I have to draw attention with regard to this spectroscope. I have insisted on the importance of the slit; but you will see in a moment that the image of a star, if it is a good image, will be a mere point in the telescope, and therefore, while a slit is not absolutely necessary, it is essential to have some arrangement by which that point of light, the spectrum of which would be merely a line, and therefore not broad enough to enable us to see what the lines are which we may expect in the spectra of stars, if they be anything like the spectrum of the sun, shall be turned into a band. That has been accomplished by means of a cylindrical lens, its function being to leave the light alone in one direction, but to turn it into a band in another direction, so that when the light of the star gets through such a lens, it is no longer a point but a line, and this is then grasped by the collimating lens, sent through the prisms, and received by the observing telescope, so that when you get the image of it in the observing telescope, instead of having a line of light so fine that the lines in it cannot be distinguished, it is a distinctly broad band in which the lines can be observed. As this lens is simply a contrivance for enabling the eye to see about where there is a line, I submit now, as I submitted some years ago, that a proper place for it is close to the eye, between the eye and the image. I have been gratified to find that, in many of the spectroscopes used on the Continent, this arrangement is adopted.

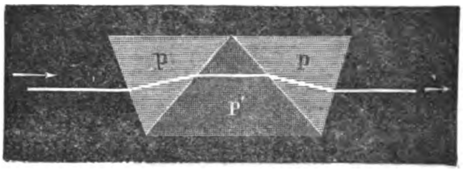

FIG. 17.—Direct-vision prism with three prisms.

We have now an idea of the action of the simple prism. I will next bring to your notice another kind of prism, which differs from the simple one very much as the achromatic telescope differs from the non-achromatic one, which was the first attempt made at an instrument for astronomical observations. Many of you know that the object-glass of a telescope, as now constructed, consists of two lenses made of different kinds of glass. Of course, we have dispersion and deviation at work in both these kinds of glass, but the lenses are so arranged, and their curves are so chosen, that, as a total result, the deviation is kept while the dispersion is eliminated, so that, in the telescope, we have a nearly white image of anything which gives us ordinary light, although, as you know, it is by the deviation alone that we are enabled to get the magnified image of that object. So also in the spectroscope we have an opportunity of varying the deviation and the dispersion. By a converse arrangement we can keep the dispersion while we lose the deviation; in other words, we have what is called a direct-vision spectroscope. If we take one composed of two prisms of one kind of glass which possesses a considerable refractive power, and three prisms of another kind which does not refract so strongly, arranged with their bases the opposite way, the deviation caused by the two prisms in the one direction will be neutralised by the deviation of the three prisms in the opposite direction; whilst the dispersion by the three prisms, exceeds that which is caused by the two prisms in the opposite direction, the latter dispersion therefore will neutralise a portion only of the dispersion due to the three prisms. The final result is that there is an outstanding dispersion after the deviation has been neutralised, so that when we want to examine the spectrum of an object we no longer have to look at it at an angle. No doubt you recollect the angle that was made by the light the moment it left the prism, but we have an opportunity, by this arrangement, of seeing the spectrum of an object by looking straight at the source of light: in the application of spectrum analysis, especially to the microscope and telescope, this modification—due to M. Janssen, the well-known astronomer, who was the first to bring it into general notice—is one of great practical importance, so that in any research which does not require excessive dispersion, this direct-vision arrangement is getting into common use. I have here another direct-vision arrangement which is well worthy of being brought to your notice. It does not depend at all upon the principles I have just been trying to explain to you. It is called the Herschel-Browning direct-vision spectroscope, in which the ray is refracted and reflected internally, in the prisms themselves. We have therefore, in addition to the simple prism which I formerly brought to your attention, two other aids to research of extreme value in certain classes of observations. The direct-vision spectroscopes which are now sold are made on one of the two principles just described; some of them are made so small that they can be easily carried in the waistcoat-pocket, and still are so powerful that all the principal, and many of the less prominent, lines in the solar spectrum may be seen with them.

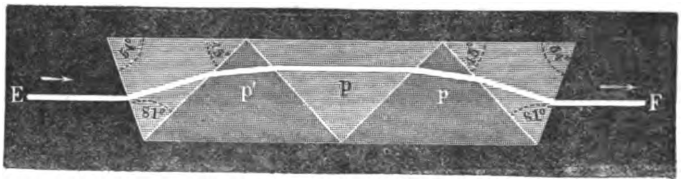

FIG. 18.—Direct-vision prism with five prisms.

Of the special application of the spectroscope to the microscope I need say but little now. The spectroscope thus used is a direct-vision one, this form being far more convenient for attaching to the microscope. The light which illuminated the object in the microscope was first of all passed through a prism; but in later arrangements it passes through the prism in its passage from the object. This is obviously a much better plan, because, in the first instance, you could only deal with transparent objects; but here, as you deal in any case with the light that comes from the object itself, it is quite immaterial whether the object be opaque or transparent.

J. NORMAN LOCKYER

(*To be continued.*)

SCHOLARSHIPS AND EXAMINATIONS FOR NATURAL SCIENCE AT CAMBRIDGE, 1873

THE following is a list of the Scholarships and Exhibitions for proficiency in Natural Science to be offered at the several Colleges in Cambridge during the present year :—

TRINITY COLLEGE.—One or two of the value of about 80*l.* per annum. The examination will be on April 5, and will be open to all Undergraduates of Cambridge and Oxford, and to persons under twenty who are not members of the Universities. Further information may be obtained from the Rev. E. Blore, Tutor of Trinity College.

ST. JOHN'S COLLEGE.—One of the value of 50*l.* per annum. The examination (in Chemistry, Physics, and Physiology, with Geology, Anatomy, and Botany) will be in December, and will be open to all persons who have not entered at the University, as well as to all who have entered and have not completed one term of residence. Natural Science is made one of the subjects of the annual college examination of its students at the end of the academical year, in May; and exhibitions and foundation scholarships will be awarded to students who show an amount of knowledge equivalent to that which in classics or mathematics usually gains an exhibition or scholarship in the college. In short Natural Science is on the same footing with Classics and Mathematics, both as regards teaching and rewards.

CHRIST'S COLLEGE.—One or more, in value from 30*l.* to 70*l.* according to the number and merits of the candidates, tenable for three-and-a-half years, and for three years longer by those who reside during that period at the College. The examination will be on April 1, and will be open to the undergraduates of the College; to non-collegiate undergraduates of Cambridge; to all undergraduates of Oxford; and to any students who are not members of either University. The candidates may select their own subjects for examination. There are other Exhibitions which are distributed annually among the most deserving students of the College. Further information may be obtained from John Peile, Esq., Tutor of the College.

CAIUS COLLEGE.—One of the value of 60*l.* per annum. The examination will be on April 1, in Chemistry and Experimental Physics, Zoology, with Comparative Anatomy, Physiology, and Botany, with Vegetable Anatomy and Physiology; it will be open to students who have not commenced residence in the University. There is no limitation as to age.—Scholarships of the value of 20*l.* each, or more if the candidates are unusually good, are offered, for Anatomy and Physiology, to members of the college.—Gentlemen elected to the Tancred Medical Studentships are required to enter at this College; these Studentships are four in number, and the annual value of each is 113*l.* Information respecting these may be obtained from B. J. L. Frere, Esq., 28, Lincoln's Inn Fields, London.

CLARE COLLEGE.—One of the value of 50*l.* per annum, tenable for 3½ years. The examination (in Chemistry, Chemical Physics, Comparative Anatomy, and Physiology, and Geology) will be on March 26, and will be open to students intending to begin residence in October.

DOWNING COLLEGE.—One or more of the value of 40*l.* per annum. The examination (in Chemistry, Comparative Anatomy, and Physiology) will be early in April, and will be open to all students not members of the University, as well as all undergraduates in their first term.

SIDNEY COLLEGE.—Two of the value of 40*l.* per annum. The examination (in Heat, Electricity, Chemistry, Geology, Zoology and Physiology, and Botany), will be on April 1, and will be open to all students who intend to commence residence in October.

EMMANUEL COLLEGE.—One or more of the value of 50*l.* tenable for two years. The examination on April 1 will be open to students who have not commenced residence.

PEMBROKE COLLEGE.—One or more of the value of 20*l.* to 60*l.* according to merit. The examination (in June, in Chemistry, Physics, and other subjects) will be open to students under twenty years of age.

ST. PETER'S COLLEGE.—One from 50*l.* to 80*l.* per annum, according to merit. The examination, date not yet fixed, in Chemistry, Comparative Anatomy and Physiology, and Botany, will be open to students who will be under twenty-one years of age on October 1, 1873, and who have not commenced residence.

KING'S COLLEGE.—One of the value of about 80*l.* per annum. The examination, on April 21, will be open to all candidates under twenty, and to undergraduates of the College in their first and second year. There will be an examination in elementary classics and mathematics, in addition to three or more papers in Natural Science, including Physics, Chemistry, and Physiology.

Although several subjects for examination are in each instance given, this is rather to afford the option of one or more to the candidates than to induce them to present a superficial knowledge of several. Indeed, it is expressly stated by some of the colleges that good clear knowledge of one or two subjects will be more esteemed than a general knowledge of several.

Candidates, especially those who are not members of the University, will, in most instances, be required to show a fair knowledge of classics and mathematics, such, for example, as would enable them to pass the previous Examination.

There is no restriction on the ground of religious denomination in the case of these or of any of the Scholarships or Exhibitions in the colleges or in the University.

Further information may be obtained from the Tutors of the respective Colleges.

It may be added that Trinity College will give a Fellowship for Natural Science once, at least, in three years: and that most of the Colleges are understood to be willing to award Fellowships for merit in Natural Science equivalent to that for which they are in the habit of giving them for Classics and Mathematics.

NOTES ON ZOOLOGY AND BOTANY IN LISBON

LISBON possesses a remarkable natural history collection which is at present in process of transference to the new Polytechnic School buildings, which are only just completed This institution is of imposing dimensions, built in the form of a square, with a quadrangular garden in the centre, and contain spacious and well-lighted laboratories, lecture rooms, and galleries for museum purposes. On the ground floor is a mineralogical and palæontological collection, and over this is the natural history series, which is contained in four fine rooms, one of which is devoted entirely to the African fauna, in which the museum is particularly rich. In all the rooms table cases are placed down the central line containing the collection of shells, which is very fine and well arranged, whilst upright cases are ranged along the walls and are filled with stuffed Mammalia, and birds, and variously preserved reptiles and fish. Amongst the Mammalia are two manatees, a fine specimen of the Aye-Aye, *Cheiromys*, and also one of the curious little otter-like animals from Africa, *Potamogale velox*, which has its tail flattened out into a vertical rudder. These are mentioned as rarities. The series is large and especially good in insectivora, moles, shrews, &c.

The birds are quite remarkable for the excellence of their preservation, and as the series is very extensive, it forms the chief feature of the collection. There are a large number of rarities, amongst which may be mentioned a perfect specimen of the great auk, *Alca impennis*, in excellent plumage and preservation, *Didunculus strigirostris*, and a fine series of Birds of Paradise, including *Semiopteryx*.

Amongst the reptiles are large specimens of *Alligator nigra*, and a large number of *Chelonia*, and amongst the fish a fine series of *Selachians*. There is also a collection of the skeletons of vertebrata, and a large number of Invertebrata, corals, sponges, starfish, &c.; but this part of the collection is not yet arranged in the new building. The natural history department is under the direction of Prof. Barboyo du Bocage, who, it will be remembered, first described the siliceous sponge, *Hyalonema*, from Setubal Bay and on the Portuguese coast.

About a mile and a half or two miles from the heart of the city of Lisbon on high ground is the Botanical garden. The garden consists of two terraces, one above the other. The lower terrace contains nothing remarkable except a group of date palms, *Phœnix dactylifera*, one of which is about 45 ft. high, which are now in various stages of flower and fruit. On the upper terrace are two glass houses, but in bad repair and apparently not containing anything remarkable. But growing in the open air is a splendid specimen of the dragon tree, *Dracœna araco*, with a perfectly circular head of foliage, which must be 36 yards at least in circumference, whilst the stem is about 16 feet in circumference. The tree was covered with the dried remains of its fruit. *Aloe arborescens* is plentiful in the garden and indeed all over Lisbon, and is now in flower. Also growing in the open air are *Musa paradisiaia*, *Ficus elastica*, *Euphorbia veriifolia*. There is a nice series of plants classified according to their natural orders, the aloes and cactuses being well represented; but the whole garden has been allowed to fall into neglect, and presents a dreary appearance, being overrun by weeds, and most of the beds are nearly choked. It is intended to abandon the garden as a botanical one, and remove as many plants as possible to the garden attached to the new Polytechnic school, but it is to be hoped that the *Dracœna* will not be neglected. The flora generally which one meets with in Lisbon is most remarkable; Australian and Brazilian acacias abound in all the gardens, and thrive and become large trees. There is quite a rage for Eucalypti, which are said to grow as much as 14 feet in height here in a single year. They are to be seen everywhere, and some species are at present in blossom. At Embia, in the neighbourhood, tree ferns grow in the open air, and in the grounds of the King's palace besides *Chamœrops* and *Phœnix dactylifera*, which are common in gardens about the town, *Jubœa spectabilis* and the Seychelle double cocoa-nut palm, *Lodoicea*.

H. N. MOSELEY

NOTES

MR. COLE, we regret very much to say, after fifty years public service, has announced his intention of resigning his post in connection with the Science and Art Department. It would be difficult indeed to estimate the extent and value of the services performed by Mr. Cole in behalf of science, services which have hitherto been most inadequately recognised, though we are certain this will not now be long the case. He has done more than any other man in the kingdom to establish schools of science throughout the country and to foster scientific instruction in every way, and that, too, in the face of opposition from quarters from which it would have been little expected.

PROF. SYLVESTER, late of the Royal Military Academy, Woolwich, has been elected a corresponding member of the Imperial Academy of Sciences of St. Petersburg.

WE have with great pleasure recorded from time to time the encouragement given to the study of Natural Science in our Universities and public schools, and are glad in reporting progress to notice that the governors of the Giggleswick Grammar School are carrying out the spirit of recent legislation in providing for the wider education which the age has called for. Giggleswick is an ancient village close to which, on the opposite side of the river Ribble, the more modern town of Settle has sprung up. Situated at the foot of the mountainous moorlands of north-west Yorkshire, where the Ribble quits its rocky gorges to wander over a wide rich valley, where peaty flats represent ancient lakes, this has long been known as a most interesting spot by the naturalist and antiquary. It was fortunate therefore for the cause of Natural Science, that the existence of an old well-endowed institution induced the Commissioners to fix upon Giggleswick as the chief school of a large district in the north of England, embracing some of the most important towns in Yorkshire. It so happens that in the immediate neighbourhood there are several very interesting caves, the exploration of which is being carried on by a Committee, amongst whom are many of our leading men of Science. The Committee have handed over the whole of the valuable remains obtained from the caves to the governors of the school, on the understanding that they will provide for their safe keeping and exhibition to the public. The Council of the Leeds Philosophical Society have followed up this by promising a very large series of duplicates from their museum, and the able curator of the Leeds Museum has undertaken to assist in the arrangement and classification of the collection. It is the duty of all scientific men to watch and encourage all *bonâ fide* efforts to give a prominent place to the teaching of Natural Science in our schools, especially where, as in this case, it is combined with a movement to form a scientific centre where illustrative specimens may be examined; and it is to be hoped that by-and-by all the standard works on scientific subjects may be consulted by a wide circle outside the school. The names of Sir James Shuttleworth, one of the governors of the school, and of Sir Charles Lyell among the supporters of the movement, offer a sufficient guarantee as to its character.

THE following extracts from a letter of Mr. Alexander Agassiz will be read with interest. It will be seen from them that the great fire at Boston did not spare the labours of scientific workers. The passage which refers to the health of his father, Prof. L. Agassiz, will give especial satisfaction to every naturalist on this side of the Atlantic:—"I am just in the middle of my Echini. I have had a very narrow escape with my book. The great fire, which has destroyed half Boston, came near to putting a stopper on my work. The plates of nearly one-third of the whole edition have not been printed, as the stones were lost in the fire. Fortunately I had about three hundred copies of the plates of parts I. and II. at the Museum out of the way, so must manage as best I can with that number. I lost, in addition, the stones of six plates of anatomy, with all the original drawings, which had been sent to the lithographer for lettering the plates. This is more serious, as it represents over a year's hard work, and the bulk of the notes being on the back of the drawings, it will delay the publication of my book for a good while. Parts I. and II. are at last out. My father has returned from his long trip a much better man than when he left, and it looks as if he would do a good amount of work yet. He has not been in such excellent health for many years."

THE increasing use of scientific terms in popular literature may be a good sign, but such terms have now and then to do unwonted duty. Witness a passage from a new tale entitled "Little Hodge," by the author of "Ginx's Baby." It is out of a pathetic description of a very small new-born child being weighed in the workhouse. "'Poor little creetur!' said the nurse, taking up the morsel of humanity from its uncomfortable position in the workhouse scales, which had been brought up from the kitchen expressly to test its *specific gravity*." We hasten to add that we infer from this a slight confusion in the author's mind, not an accusation against our workhouse officials of weighing new-born babies under water for experimental purposes.

We understand that the Fellows of the Chemical Society have started a Chemical Club, one of the objects of which is to promote the contribution and discussion of original papers to the society, and to encourage good fellowship amongst its members. The number of members is limited to fifty, and we hear that there are only a few vacancies remaining. The meetings of the club take place once a month, when the members dine together before adjourning to the evening meeting of the Chemical Society.

We are glad to notice the formation of a society at New Cross, entitled "The New Cross Microscopical and Natural History Society," which meets at the Commercial Rooms, Lewisham High Road. The society has, we believe, made a good start, and will be glad to receive additions to its membership, and we hope that all who join it will remember that the best way to ensure success for such a society is by every member striving to take a share in the work. By means of exhibitions, the formation of natural history cabinets, microscopical work, excursions, lectures and papers, the society seeks to carry out its objects. The subscription is small, only ten shillings a year. Further information may be obtained from the hon. sec., Mr. Martin Burgess.

The sixth annual Soiree of the Old Change Microscopical Society will be held at the City Terminus Hotel, Cannon Street, on Friday evening, February 28.

The *Challenger* arrived at Gibraltar on Saturday, and is expected to leave to-day for Madeira.

Mr. Prescott Hewett has been elected President of the Clinical Society of London, in succession to Sir William Gull.

Sir John C. Burrows, F.R.C.S., Mayor of Brighton, who gave such a splendid reception to the British Association last year, has just received the honour of knighthood.

Lord Neaves is to be formally installed as Lord-Rector of the University of St. Andrews, on February 13. We understand Lord Neaves is to offer four prizes annually during his term of office, to be competed for by students attending the University.

We announced last week that Mr. W. Saville Kent has been appointed resident naturalist and curator of the Brighton Aquarium, in room of the late Mr. J. K. Lord. We believe Mr. Kent is to have the assistance, as consulting naturalists, of Messrs. Henry Lee and Frank Buckland, while Mr. Reeves Smith, late of the Spa at Scarborough, has been engaged as general manager and secretary. Under Mr. Lee's advice and superintendence important changes and improvements are already being effected. Fishes of incongruous species, which have lately had joint possession of some of the tanks, are being separated and placed in those best suited to their habits; whereas only six tanks have hitherto been set apart for the exhibition of fresh water fishes, eight additional ones have now been prepared for them, which can be reconverted into receptacles for marine specimens in a few hours in case of need. Tanks for the storage of a reserve of specimens apart from public view are in course of construction, and arrangements are being made for careful observation of the marine invertebrata and other forms of aquatic life. It has also been proposed that a series of microscopes shall be provided, by means of which interesting living and mounted objects, illustrative of the minute organisms developed in the tanks shall be exhibited to the public. This indicates a serious intention to utilise the great resources of the Brighton Aquarium, as they should be utilised for the purposes of experimental and practical zoology, by affording opportunity for careful researches and investigations which may prove of scientific interest and economic value.

We have received a copy of the *Mobile Register* for December 15 last, containing a letter from Mr. A. W. Dillard, in which he endeavours to account for the generally acknowledged increase in the severity of the winters in Alabama. In all European countries it is commonly believed the climate has become warmer in proportion as the forests have been felled and the land cultivated. In Alabama, however, similar operations have apperently produced opposite results. The writer, however, believes that the general dryness of Africa, and especially of the Great Desert, has no inconsiderable effect on the climate of Europe, and accounts for the great difference of temperature between the same latitudes in Europe and America. He accounts for the change of climate in Alabama and other southern American states in the following way:—"The felling of our Southern forests gives a more unrestricted scope to the north-western winds, chilled by the snow on the Rocky Mountains and the ice of the northern lakes and rivers. These bleak winds are not counteracted by warm gales, blowing from a dry country, such as Africa; consequently they exert all their chilling influence on our climate. The gales which we have from the south are impregnated with a good degree of moisture, and so add to the cold consequent upon the blowing of the wind from the north."

A despatch from Dr. Kirk, dated Zanzibar, Nov. 5, 1872, has been received at the Foreign Office. It announces that the men sent to help Dr. Livingstone had reached him, and that he had started for the interior about August 18.

In Nature, vol. vii. p. 7, we intimated that among other expeditions to the Arctic Regions was one under the command of a rich and adventurous young Frenchman, M. Pavy, that had set out from San Francisco to go by way of Wrangell Land, to the north of the eastern part of Siberia. If we can trust a report in the *Times* for January 17 from the *Courier des Etats Unis*, his hopes have been gloriously realised. for he has discovered an Arctic Continent. The account professes to be a summary of despatches, dated Wrangell Land, lat. 74·38, W. long. 176·18, August 23, 1872, committed to the care of the captain of a whaler, for the French Geographical Society, which, it is said, will publish the scientific results after having examined them. A similar account appeared some time since in the *Scotsman*. The following are the chief points of the somewhat remarkable story:—On July 17 Pavy and his party reached the mouth of the river Petrolitz. From this point they met with immense fields of ice moving towards the north-east. The observations indicated a deviation of 18 miles, caused by the movements of the ice, a fact tending to confirm the theory of M. Pavy respecting the concentration and the augmentation in rapidity of the branch of the great Japanese current, called Ku-Ro-Sirod, which passes through Behring Strait, and flows toward the east away from the coast of Siberia. The exploring party reached the coast of Wrangell Land, at the mouth of a great river coming from the north-west, which is not laid down on any map. This discovery confirms M. Pavy's theory that there exists a vast polar continent which stretches far to the north, the temperature of which is warm enough to melt snow in summer. The current of this unnamed river turns to the east, and follows the coast with a velocity of six knots an hour. M. Pavy and his companions followed the current of the river towards the north, a distance of 230 miles. Its bed is uniformly horizontal, and it is bordered by mountains of great height, with several perpendicular peaks. At 80 miles from the mouth the explorers found on the plain some vestiges of mastodons, and on clearing away the snow from a spot whence emerged the tusks of one of that extinct race, they brought to light its enormous body, in a perfect state of preservation. The skin was covered with black stiff hair very long and thick upon the back. The tusks measured 11 ft. 8 in. in length, and were bent back about the level of the eyes. From its stomach were taken pieces of bark and grasses, the nature of which could not be analysed on the spot. Over an area of many miles the plain was covered with the remains of mastodons. This region abounds with polar bears, which live on the remains of the mastodons. At 120 miles from the coast and half a league from the river, rises a vast block of ice 1,000 ft. high, the base of which is surrounded by gravel and polished rounded stones deeply sunk in the soil. The Arctic animals are very numerous in this valley, and myriads of birds fly above the river and over both of its banks. At the date of his despatches M. Pavy was preparing to winter in the 75th degree of latitude in the valley of the great river of the supposed polar continent. He considered himself certain to arrive in the beginning of next season at a polar sea of moderate temperature at the northern extremity of the continent. The explorers calculate on afterwards reaching the Atlantic through Melville Strait.

THE two principal articles in the last number of the *Bulletin de la Société de Géographie* are, one by M. Jules Gerard, on the present state of knowledge of New Guinea, in which he gives a historical account of discovery in that island, and a description of its geography, ethnography, natural history, meteorology, its colonisation and commercial relations. This is accompanied by a good map. The other is an account of the river Amazon, and the region through which it flows, by the Abbé Durand, compiled from various geographical memoirs. The same number contains a letter from the Abbé Desgodins, pointing out, apparently from personal knowledge of the region concerned, a number of errors in Mr. T. T. Cooper's "Travels of a Pioneer of Commerce."

WE have received the programme of "The Leeds Naturalists' Field Club and Scientific Association," for the next three months. It meets every Tuesday evening, alternate meetings being devoted to the reading of papers and to the exhibition of specimens, with general discussion on scientific subjects. During the first three months of 1873 the following papers will be read:—Rev. John Hanson on "The Development or Transformation of Insects." Mr. James Abbott, vice-president, on "The Anatomy of the Slug." Mr. Geo. Ward, F.C.S., "Observations upon the Element Carbon." Mr. Edwin Birchall, on "The Origin and Distribution of the Insects of the British Islands." Mr. Wm. Todd, vice-president, on "The Silurian Rocks and Fossils." The annual meeting will be held on March 25.

THE last number of *Memorie della Società degli Spettroscopisti Italiani*, contains drawings of the chromosphere as observed at Rome, Naples, and Padua during January, February, and March 1872.

THE first number of *Iron*, the name of the new series of the *Mechanic's Magazine*, is printed on a very much larger size of paper than its predecessor, and contains a number of useful articles, mostly on the practical applications of scientific principles. We wish *Iron* a long and successful career.

THE principal paper in the *Revue Scientifique* for January 18, is a continuation of the article on "The Observatories of Great Britain," in which details are given concerning the Observatories at Edinburgh, Dublin, the Cape of Good Hope, Madras, Melbourne, Paramatta (New South Wales), Sydney, and Lucknow.

WE learn from the *Medical Record* that a new faculty of medicine is about to be instituted at Geneva.

THE STAR SHOWER AS SEEN AT MAURITIUS

A GREAT shower of meteors was observed in this colony on the night of November 27 last. I had not myself the good fortune to see it, but it was seen by several other persons who have obligingly communicated their observations.

At the Observatory it is customary to watch, as far as possible, for meteors during the whole of November, but, on the night in question, the sky was nearly overcast. At 9.15 P.M. we had a shower of rain, and at 9.30, when the last observation of the instruments and of the weather was taken for the night, nine-tenths of the sky were overcast, and the weather was gloomy. Looking out about midnight from a window facing the north I observed that the visible parts of the heavens was still overcast, but remarked that the clouds were unusually luminous, as if the moon in her first or last quarter were shining behind them. This struck me particularly, and I waited some minutes in expectation of seeing a break in the clouds.

On the following day, I received a telegram from the Hon. Edward Newton, Colonial Secretary, announcing that he and Mr. C. Bruce, Rector of the Royal College, had counted from their residence, twelve miles off, and nearly 900 feet above the sea-level, 2,678 meteors between 9.30 P.M. and 12.55 A.M.; and soon afterwards I ascertained that some other members of our Meteorological Society, as well as several other gentlemen, had also observed the shower, all from the same part of the Island.

In place of attempting to summarise the accounts which have reached me, I think it preferable to give them in full, in the order in which they were received.

(1.) *Observations by the Hon. Mr. Newton and Mr. Bruce.*—"About 9.30 on the evening of November 27 we observed an unusual frequency of shooting stars. At 9.35 we began to keep regular count. We continued our observations till 12.55, at which time the frequency had greatly diminished, as will be seen from the following statement of the numbers seen in the intervals of time noted—

From	9.35	to	10.35	786
"	10.35	"	11.35	1,160
"	11.35	"	12.10	454
"	12.10	"	12.35	193
"	12.35	"	12.55	85
			Total	2,678

"The approximate time of greatest intensity of the shower was from 11 to 11.30. About this time two meteors of extraordinary brilliancy were particularly noted: the first at 11.22, and the second at 11.44.

"The former of these started from the three stars in the tail of Aries, and the luminous orb vanished somewhat south of the Ecliptic. The train of this meteor was distinctly visible for 4 minutes. At the vanishing moment of the luminous point, it slowly wheeled from horizontal to vertical, and was seen for nearly two minutes vertical to the horizon.

"The latter, starting from a point at right angles to the three stars in the tail of Aries and the Pleiades, passed through the Pleiades, Taurus, and Orion, and vanished near Sirius. Its train was visible for more than a minute.

"Nearly all the meteors observed radiated from a point near Aries, nearly at right angles with the Pleiades, and shot either in the direction of the bright meteor of 11.44, or in a line through Aries, cutting the ecliptic and vanishing to the S.

"From eighty to ninety per cent. of the meteors were followed by a soft, broad train of light, visible for a few seconds after the vanishing of the luminous point, of diameter at least equal to the luminous orb, and extending from 10° to 20°. In the case of the two bright meteors above mentioned, the train of light extended over at least 40°.

"During our observations, portions of the heavens were from time to time obscured by dark fleeting clouds, which at times obscured the starting and vanishing points.

"Between 10 and 11 we observed occasionally a pulsating coruscation, similar to the appearance of the Aurora Australis. Mr. Meldrum, however, informs us that the instruments at the observatory gave no indication of a magnetic disturbance.

"In colour the majority of the meteors seemed to be equal in purity to that of the most colourless stars.

"Taking a point as above described as visible radiating point, the angle of the majority of the meteors was about equal to that of the meteors figured in 'Johnston's Astronomical Atlas,' seen in November 1866.

"A few however, shot with extreme velocity towards the north; these had no trains of light; other meteors shot parallel to the general direction close to the horizon. Although we discontinued our observations at 12·55, the shower was not over, and a few meteors were seen near the western horizon after this time.

"It must be observed that the point from which our observations were taken was obscured by trees in the directions of the western horizon. About the time of greatest intensity, nine meteors were visible at the same moment.

"During the greater part of our observations, up to midnight, the radiation of these four or five meteors was nearly synchronous.

"Towards the time of the greatest intensity, one of the observers was absent for about fifteen minutes, and it is probable that many meteors during this interval escaped observation."

(2). *Observations by Lieut.-Colonel O'Brien, Inspector-General of Police, and Mr. A. Brown.*—"At about 10 o'clock last night (Nov. 27) our attention was drawn to the number of falling stars. Going outside and standing back to back, Mr. A. Brown and myself in a short time counted no less than 110. This continued till near 11 P.M., when we went out again, and in five minutes counted 118. Some of these meteors were very bright, having tails like comets. Their course was generally longer than that of the others, and they seemed nearer to the earth. The course of the shower was almost invariably from north to south, and more meteors were visible towards the southern hemisphere than in other quarters."

(3). *Observations by the Hon. Robert Stein and Mr. A. C. Macpherson.*—"On November 27, about 10·15 P.M., on looking towards the N.E. we noticed several meteors falling; the Pleiades, Hyades, and Orion being at that time about 45° to 50° above the horizon.

"On observing carefully, we found the meteors in great numbers coming from due north very much on a level with the stars above mentioned, and rather farther to the north of the Pleiades than the distance between the Pleiades and Hyades.

"They came not from a point, but as it were along a broad belt crossing the sun's path nearly at right angles, appearing at times in the north, but often also at the zenith and towards the southern horizon, passing as it were parallel, some from N.E. to S.E., some from north to south, and some from N.W. to S.W.

"The number of meteors was so great, and they appeared so irregularly, sometimes towards the north, sometimes overhead, sometimes to right or left of the zenith, and sometimes towards the southern horizon, that we could not keep count of them; but from 10.15 to 10.30 they appeared to be falling at about the rate of one in every second, sometimes singly, and sometimes in twos or threes at a time. The more distant ones showed only bright luminous points, but the nearer ones every few minutes showed trains and sparks like a rocket, varying from 2° or 3° to 5° or 6° in length, and seldom reaching a length of 10°.

"Our view to the S.W. was partly closed, but on changing position, so as to get a view of that quarter, I found the meteors falling there too; but it appears to me during the short time I looked in that direction, towards eleven o'clock, as if fewer were falling there than I had observed to the eastward of south."

(4.) *Observations by Mr. W. H. Marsh, Assistant Colonial Secretary.*—"I observed the shooting stars at first at 9 o'clock. The sky was cloudy, but in spaces that were occasionally left clear, the meteors could be seen going from north to south. About half an hour later the sky was quite clear. I counted 100 shooting stars in less than five minutes. With the exception of one in Andromeda, which went in an easterly direction, they all went to the south. I continued observing till 10.30. The meteors were almost entirely confined to the western half of the heavens, and by far the greater number was observed in Aquarius and in the neighbourhood of Fomalhaut. Most of them were very dim and small, but occasionally a bright one made its appearance. I observed a very bright one at about 10·15, which came from the direction of the zenith, and appeared to pass right through the Star Achernar."

Observations by Capt. Fry.—"On the evening of November 27 my attention was drawn towards the heavens by seeing an immense number of stars of all magnitudes shooting towards the south from Orion, which was at the time about 30° above the eastern horizon, in a straight line through the zenith to about 40° above the western horizon, below which altitude clouds obscured the sky. The greater number seemed to move from the southern side of the above described line. They were all exceedingly bright, and varied in size from an ordinary meteor to *infinitely* small. The time was from 9 to 10.15 P.M., when clouds screened the view. I endeavoured to keep count, but could not, owing to the immense number and the quickness of their movements. I am an old mariner, and have often had opportunities of watching the heavens at night, but I never witnessed anything to compare to the sight on the night of the above date. On the 28th I made preparations to watch for a repetition of the spectacle; but not having seen more than is observed on an ordinary night, say four or five, I gave it up, and retired at 11 P.M."

Observations by Capt. Gaston, of the Ship "Pénélope," from Vohemar to Mauritius.—"Le Mercredi, 27 Novembre, étant par une latitude de 19° 52′ Sud et 50° 25′ longitude Est, le temps était magnifique, mais calme. Vers 7h. ¼ du soir une chose rare se montra au firmament; une quantité extraordinaire de météores parurent successivement, se formant dans le Nord, allant dans leur course vers le Sud-Est. Les uns donnaient une clarté très vive et d'autres ne laissaient qu'une légère trainée de feu ressemblant á des fusées; mais tous allaient avec une grande rapidité. Ce manége de petits météores dura jusque vers 2 heures du matin.

"Un autre fait non monis curieux s'etait présenté dans la journée. Tous les marins connaissent l'Alcyon (ou hirondelle de mer) et tous savent que ces petits oiseaux se tiennent dans les eaux du Navire, mais en petite quantité. Nous avons, pour ainsi dire, été assaillis par ces oiseaux, les uns voltigeant autour du navire et les autres posés sur l'eau assez près les uns des autres, ce qui ressemblait á une masse noire."

The above observations, with the exception of Capt. Gaston's, were all taken within a circle of three miles in diameter, and at altitudes of 700 to 1000 feet.

There are, as might be expected, some discrepancies in the accounts given, but it appears to me that the meteors were seen in two streams, the one passing through Aries, Pisces, and Aquarius, nearly along the Ecliptic, and the other through Orion towards Sirius, while others passed through the zenith from north to south.

The radiant point would appear to have been close to the stars ο and ζ in the foot of Perseus, near the spot indicated by Mr. Newton and Mr. Bruce. Mr. Stein, however, probably from his seeing only a part of the sky, thinks there was no radiant point. I have not seen him since I received his description; but from verbal explanation given by Mr. Bruce and Mr. Marsh, and from Capt. Gaston's account I think the meteors shot from the above-mentioned point. Mr. Bruce informs me that he observed a meteor pass from Northward close to and parallel with ε and α Tauri; and Mr. Marsh mentions that he saw one pass from near the zenith right over Fomalhaut.

I think there must be some mistake in the statement that many meteors shot from Orion through the zenith to the meteor horizon.

With regard to the time of maximum intensity it must have been at 11, or soon after.

The shower was evidently not equal in splendour to that of November 14, 1866.

Watch was kept up during the night of the 28th to 29th, but the few meteors seen did not radiate from any point.

The number of the meteors seen from the 12th to the 15th was not greater than on ordinary nights.

On referring to Quetelet's Catalogue, I find mention of only three showers seen about November 27, one on November 25, (16th Jul. Cal.) 1602, a second on November 25, 1822, and a third on November 29, 1850.

While on the subject of meteors, I beg to send an account of an extraordinary one seen here by the Rev. Mr. Wright on the night of November 7 last. [See this week's Correspondence.] Mr. Wright's description, in several respects, applies to the moon, which was at the end of her first quarter, and in the part of the heavens indicated. Has any similar meteor been seen in former times? It was totally different in form and appearance from the great meteor of Nov. 27, 1862.

C. MELDRUM

Mauritius, Dec. 12, 1872

*SCIENCE IN ITALY**

THE energetic revival of scientific activity in Italy, to which attention has been before directed, is still progressing satisfactorily. The mere fact that the Transactions of the Royal Institution of Lombardy report the proceedings of the sittings of the 24th June, of the 4th and 18th of July, of the "ordinary sittings of the 1st August," and "the solemn sittings of the 7th of the same month," afford to any Englishman who has *summered* on the Plains of Lombardy, very strong presumptive evidence of scientific enthusiasm and industry. Even in our lukewarm climate such meetings are suspended during the summer months, in spite of the insatiable activity of Englishmen. It does not appear that the worship of the "*dolce far niente*" has profaned the Milanese shrine of science.

In the course of these summer meetings thirty-nine original papers, besides academical reports and addresses, were read. During the year ending August 7, ninety such papers were read in the Department of the Mathematical and Natural Sciences, including subjects in pure and applied mathematics, hydraulic engineering, physical geography, astronomy, experimental physics, chemistry, natural history, animal and vegetable physiology, geology, agriculture, anthropology, anatomy, pathology, surgery, therapeutics, hygiene, medical statistics, and the history of science. In addition to these a number of original papers were read in the Department of Literature and Moral and Political Science. This statement of the quantity of work done is a sufficient exeuse for my not attempting anything like a complete analysis of it. A few of the most interesting papers may however be mentioned.

June, 20.—"On the Anthropometry of 400 criminals in the Penitentiary of Padua." This is an analysis and a summary of the results obtained by Dr. Pellizzari and Dr. Berretta, the full record of which fills a large volume. Some curious results come out of the tables of these measurements. The tallest and heaviest men are those who have committed murder and manslaughter; the shortest and lightest those who have committed rape. The head measurements are very interesting and suggestive, sufficiently so to warrant a continuation of such investigations over an area sufficiently large to obtain more reliable averages than the 400 measurements afford. There is another paper of the same date by Dr. Giglioli, that I suspect will prove very interesting to comparative anatomists, on some remarkable teeth of whales (Cetodonti) that were collected by Sig. Corelli, among other things, during a residence of forty years at Rio de Janeiro.

July 4.—"On the epoch of the upheaval of the sienitic rocks of the chain of Adamello, in the Province of Brescia."—"On another analogy between electrical and magnetic polarity," by Prof. Cantoni. (Another paper in continuation on the same subject was read on July 18.)—Note on the "Heat of Combination of Bodies," by Prof. Cantoni. This contains some suggestive speculations on the philosophy of thermodynamics, in which the author points out experimental difficulties, and goes a long way in the direction of atom-splitting, in order to find an explanation. He compares the combination of two chemical atoms or molecules, to a collision between two stellar systems or nebulæ, where the development of heat would not be merely that due to the velocity of each system considered as a whole, but in addition to this, to the disturbance of rotatory and orbital motion of the planets, satellites, &c., within each system. He supposes the ordinary atom or molecule to be a system of minor atoms, having orbital and rotatory movements, the disturbance of which, when atomic collision occurs, contributes to produce the heat of combination. It is not for me, a heretical disbeliever in the existence of either atoms or molecules, to make any comment on the merits of such a hypothesis.

"On the Drainage of the Lago Fucino" by Carlo Possenti, refers to an important undertaking which is proceeding at the cost and risk of Prince Torlonia. The author points out the difficulties and possible sources of failure of the enterprise.

"On the Prediction of the Movement of Tempests and the Phenomena which accompany them," by M. Harold Tarry, Vice-Secretary of the Meteorological Society of France; communicated by Prof. Schiaparelli. This is an exceedingly interesting paper, mainly based upon observations made by the author on the great cyclones which have deposited in Italy some of the sand uplifted from the desert of Sahara, &c. It is worthy of a special and separate abstract.

July 18.—"On the Velocity of Molecular Movements in Aeriform Fluids," by Prof. Brusotti. This is a contribution to the mathematical theory of thermodynamics.

"On the Origin of Atmospheric Electricity," a series of experiments on the electrical disturbances due to the rarification and condensation of air, both in its ordinary condition and when subjected to artificial dessication with a view to answer the question proposed.

"On the Burning of Dead Bodies," by Dr. G. Polli. The author points out many sanitary, economical, and sentimental objections to the existing customs of burying the dead, and advocates a revival of the ancient system of rapid decomposition by burning and preservation of the ashes, in order to satisfy sanitary requirements of the public, and the affections of friends and relatives.

Prof. Corradi contributed a long and interesting account of the voluminous manuscripts of Lazzaro Spallanzani, obtained in 1801 by the communal library of Reggio from Dr. Nicolo Spallanzani, the brother of Lazzaro. A perusal of this paper shows that the industry and attainments of this great naturalist were more extensive than we are accustomed to suppose in England. His manuscripts in Italian, French, and Latin are collected in 193 volumes, and include travelling diaries, notes of experiments and observations, letters, &c., some of which have been already published.

Besides these I may refer to Prof. Stoppani's observations on the eruption of Vesuvius April 24, 1872, and also to Prof. G. Cantoni's researches on the Rust of Wheat; but cannot attempt any account of their contents without extending this notice much beyond its proper limits.

The "solemn sitting" of the August 7 was chiefly devoted to the annual addresses of the Secretaries of the Mathematical and Physical, and of the Literature and Moral and Political Departments, Sig. Luigi Cremona, and Sig. Guilio Carcano, and to other annual business.

I should add that a monthly meteorological report is regularly published, with the Transactions of this society.

The papers in the Department of Literature and Moral and Political Science are few in number. Passing over the mere literature altogether, I may refer to one paper on a strictly scientific subject which in Italy, as in England, is too commonly left in the hands of mere talkers and writers, who *discuss* many things and *investigate* very few or none. I allude to political economy, and to a paper by Prof. Marescotti on Rent and Profit. This paper abounds in political argument, rather than political science. The author describes the rent of land as the remuneration of the landed proprietor for the capital which he has invested in rendering the soil productive, and although writing for the purpose of justifying the payment of rent, appears quite unacquainted with Ricardo's demonstration of the natural and independent origin of rent, as another element totally distinct from the reimbursement of the proprietors' outlay on the land.

The summer and autumn numbers of the *Gazetta Chemica Italiana*, and the Transactions of the Academy of Sciences of the Institute of Bologna must be reserved for another notice.

W. MATTIEU WILLIAMS

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* "Rendiconti del Reale Istituto Lombardo," for July, August, and September, 1872.

SCIENTIFIC SERIALS

THE *Geological Magazine* for the present month (No. 103) opens with a note by the editor on fossil remains of insects which have been described in previous volumes of the magazine, as an introduction to a paper by Mr. A. G. Butler describing a most interesting wing of a butterfly belonging to the Nymphalidæ group, found in the Stonesfield slate. This butterfly Mr. Butler proposes to name *Palæontina oolitica*, and, as he remarks, it is the most ancient member of its group yet discovered.—Mr. R. H. Tiddeman describes the Victoria Cave at Settle in Yorkshire, and notices the fossils contained in the lowest deposit yet reached in the investigation of this cave.—Mr. W. Molyneux notices the occurrence of copper and lead ores in the Bunter conglomerate of Carnock Chase; and Prof. King, of Galway, communicates a paper on the microscopic characters of a silo-carbacid rock from Ceylon, and notices their bearing on the methylotic origin of the Laurentian limestones, methylotic being a term introduced by the author to express the character of rocks which have undergone change by the elimination of or additions to the substances of which they were originally composed. This paper, of course, bears indirectly on the vexed question of the nature of *Eozoon*.

Poggendorf's Annalen der Physik und Chemie, No. 11. The first paper in this number is by A. Wüllner, being a continuation from vol. cxliv. of his researches "On the Spectra of the Gases in Geissler's Tubes." The present paper gives an account of some researches undertaken by the writer along with Dr. Winkelmann to account for the origin of the different kinds of spectra, the band spectrum, the line spectrum, and the continuous spectrum. The spectrum experimented on was that of nitrogen, the media being air, hydrogen and oxygen respectively. The next paper is an abstract of a memoir by Prof. Lemström, of Helsingfors University, on the intensity of the flow of a voltaic current, which is followed by one in the department of acoustics, by J. J. Oppel, on two remarkable circumstances in connection with what he in a former paper called "Reflexionstöne" or "Gittertöne." The next paper is the first portion of the second part of Herr W. Sellmeier's paper on the subject of the vibration of molecules, which is followed by the continuation of E. Ketteler's elaborate memoir on the influence of astronomical movements on optical phenomena. The next paper is an attempt by L. Lorenz, of Copenhagen, to discover the means of determining in absolute terms, degrees of heat, and to show more clearly the relation in which heat and electricity stand to each other, which is connected to some extent with the paper which follows by S. Subic, on temperature constants. A few short papers conclude the number.

No. 12. The first article in this number is a long one by Dr. R. Börnstein, on the theory of Rühmkorff's induction apparatus, which is followed by the conclusion of the second part of Sellmeier's paper on the vibration of molecules. The next article is a criticism, by F. C. Henrici, on a paper read by Tomlinson to the Chemical Society, on the action of solid bodies on supersaturated solutions. E. Reusch contributes an article on the doctrine of twin-crystals, and J. Hervert one on transverse vibrating flames. V. Dvořák contributes an account of some experiments to test Airy's theory of the Talbot bands. Among the shorter papers is one by F. Zöllner on the reversion spectroscope.

Mittheilungen der Naturforschenden Gesellschaft in Bern aus dem Jahre, 1871.—The first part of this goodly sized volume is occupied with the proceedings of the Scientific Society of Bern for 1871. The following are some of the longer papers which make up the bulk of the volume. The first is the continuation from a former volume of Dr. Cherbuliez' Historical Résumé of Researches on the rate at which sound is propagated through the atmosphere; the same gentleman contributes some historical notices concerning the mechanical theory of heat. Considerable space is given to the continuation and conclusion of Dr. H. Wydler's contributions to a knowledge of the indigenous plants of Switzerland; and L. Fischer contributes a long list of the cryptogamic plants to be found in the neighbourhood of Bern. One of the longest and most interesting articles is by E. Schaer, being contributions to the chemistry of the blood and of ferments; the first part treating of the influence of cyano-hydrogen and phenol on certain properties of the blood corpuscles and various ferments; and the second part on the action of cyano-hydrogen and phenol on yeast and on mould-fungi. This is followed by a paper by Dr. A. Forster on the colouring of smoky quartz or topaz. The concluding paper in the volume, which is accompanied by a well-constructed map and graphic tables, is by A. Benteli, who attempts to estimate the amount of moisture precipitated by the atmosphere in the seven chief river-districts of Switzerland. The volume is altogether highly creditable to the Society whose transactions it records.

SOCIETIES AND ACADEMIES

London

Royal Society, Jan. 16.—A "Note on an Erroneous Extension of Jacobi's Theorem" was read by Isaac Todhunter, M.A., F.R.S.

Sir G. B. Airy read an additional note to his paper "On a supposed Alteration in the Amount of Astronomical Aberration of Light produced by the Passage of the Light through a considerable thickness of Refracting Medium."

Some months since, he said, I communicated to the Royal Society the result of observations on γ Draconis made with the water-telescope of the Royal Observatory (constructed expressly for testing the quality of the coefficient of sidereal aberration, whether the tube of a telescope be filled with air, as usual, or with water) in the spring and autumn of 1871. Similar observations have been made in the spring and autumn of 1872, and I now place before the society the collected results. It will be remembered, from the explanation in the former paper, that the uniformity of results for the latitude of station necessarily proves correctness of the coefficient of aberration employed in the Nautical Almanac.

Apparent Latitude of Station

		°	′	″
1871.	Spring	51	28	34·4
	Autumn	51	28	33·6
1872.	Spring	51	28	33·6
	Autumn	51	28	33·8

I now propose, when the risk of frost shall have passed away, to reverify the scale of the micrometer, and then to dismount the instrument.

Mathematical Society, Jan. 9.—Dr. Hirst, F.R.S., president in the chair.—Papers were read by Mr. S. Roberts, V.P., on parallel surfaces; Prof. H. J. S. Smith, on the greatest common divisors of the minor determinants of a rectangular matrix of which the constituents are integral numbers, and on an arithmetical demonstration of a theorem in the integral calculus (these two communications were founded upon a paper by the author, published some few years since in the "Philosophical Transactions." Prof. Wolstenholme, on the summation of certain series (read in the author's absence by the secretary). This was concerned with the obtaining of a series closely related to Vandermonde's well-known series, ; thus, Vandermonde's series being—

$$(a+b)_n = b_n + n\,b_{n-1}\,a_1 + \frac{n\,(n-1)}{1\cdot 2}\,b_{n-2}\,a_2 + \ldots + a_n$$

then the series discussed might be written—

$$(a+b)_n = b_n + n\,(b-1)_{n-1}\,a_1 + \frac{n\,(n-1)}{2}\,(b-2)_{n-2}\,(a+1)_2$$
$$+\frac{n(n-1)\,(n-2)}{3}\,(b-3)_{n-3}(a+2)_3 + \ldots + (a+n-1)_n$$

Amongst the presents received were three War Department weather maps, Signal Service, U.S. army, Washington, Friday, November 22, 1872, constructed for 7.35 P.M., 4.35 P.M., and 11 P.M.

Chemical Society, Dec. 16, 1872.—Prof. Frankland, F.R.S., president, in the chair.—"Notes on various Chemical Reactions," by Dr. Davies, contained observations on the formation of the sulphides of copper and barium, also some notes on the separation of nickel and cobalt.—Mr. H. Grimshaw communicated the results of his researches on ethyl-amyl and its derivatives. After the president had made some remarks on the thoroughness with which this research had been carried out, a communication from Dr. Schorlemmer on "The heptanes from Petroleum," was read. This paper contained, among other matter, an interesting account of the separation of isomeric heptylenes by means of hydrochloric acid.—A paper by Mr. T. Cornelley on the "Vanadates of Thallium," was then read. It contained descriptions of several new and complex vanadates of Thallium.—Mr. Kingzett communicated to the society the results of his experiments on the conversion of sodium chloride into sodium sulphide by the action of hydrosulphuric acid; and finally, Mr. P. Braham exhibited some ingenious apparatus which he had arranged for the prosecution of physical researches under the microscope.

Photographic Society, Jan. 14.—James Glaisher, F.R.S., president, in the chair.—The President delivered a lecture on the application of photography for registering magnetical and meteorological phenomena, pointing out that no other method of registration was sufficiently delicate for the purpose; the lecturer explained that the magnetical records were obtained by a mirror arrangement fitted to the moving magnet, and in this way a pencil of light was reflected upon sensitive paper wound round a cylinder, which revolved once in twenty-four hours, thus securing a wave line representing the magnetical currents of the earth during the day. Meteorological records required less complicated apparatus. The photo-chemical process employed was also explained. Dr. E. J. Gayer read a paper "On Instantaneous micro-photography," and exhibited pictures of live animalculæ in water.—Dr. E. J. Gayer also read a paper "On a cause of fading in albumenised pictures."

PARIS

Academy of Sciences, Jan. 6.—This was the annual general meeting of the Academy, and M. Faye, after delivering an address mainly devoted to the transit of Venus expeditions, vacated the chair, where he was succeeded by M. de Quatrefages.—M. Le Baron C. Dupin read a note on the French population, which, allowing for the ceded provinces, shows a decrease of 1,279,451. The decrease the Baron asserts to have been directly and indirectly caused by the late war.—M. Boussingault gave an account of his experiments on the formation of nitric compounds by the soil. He finds that these bodies are not formed from the nitrogen of the air, as he had been inclined to think.—M. A. de Caligny read an interesting paper on the effects of certain kinds of waves on sand-banks.—Further observations of 128 by M. Borrelly were received, and also M. Bossert's Elements and Ephemerides of the same planetoid.—A paper on orthogonal surfaces, by M. G. Darbonn, was then read, and followed by an answer to M. Gernez's criticisms by M. G. Van der Mensbrugghe, who defends his and Mr. Tomlinson's theory of the action of films on saturated solutions.—A note on certain phosphorous compounds, in which that body appears to exist in the amorphous (red) form, by M. A. Gautier followed.—M. A. Houzeau sent a paper on the estimation of ammonia in coal gas.—MM. Estor and Saint-Pierre sent a short note on respiratory combustion. They have made experiments which prove intra-arterial as against pulmonary combustion.—M. Sanson sent a paper on the horse of the quaternary fauna, which was followed by a note by M. Diamilla Müller on the absolute magnetic declination at Tiflis, at Sevrova, and at Paris.—M. de Rouville sent a paper on the upper Jurassic formations of the department of L'Herault.

January 13.—M. de Quatrefages, president, in the chair. M. Jamin presented his fourth note on a magnetic condenser, a description of an apparatus he has contrived, by which the power of magnets is much increased.—M. E. Mouchez read a note on the rising of the Algerian Coast.—M. H. Resal sent a note on Savart's observation of the mutual influence of two pendulums.—MM. Troost and Hautefeuille read some researches on the Allotropic forms of phosphorus; they point out the similarity of the changes of vapour density in phosphorus when undergoing allotropic modification to those of cyanic; they also state that the sudden development of heat in the case of phosphorus when at the point of change has an exact analogy in the case of the acid mentioned.—MM. F. Bagault and Roche sent a note on a new process for the manufacture of steel. The process consists of decarbonising cast iron by means of rich iron oxide ores.—An interesting mathematical paper on orthogonal surfaces was received from M. G. Darbown.—M. Gernez controverts some assertions of Van der Mensbrugghe as to the effects of liquids of high surface tension on liquids of low tension. Van der Mensbrugghe asserts that when such liquids are in contact, if the first contains a dissolved gas it is compelled to liberate it.—M. Melsens sent a note on sulphurous and chlorosulphuric acid and on the combination of chlorine and hydrogen in darkness. The author saturated charcoal with chlorine, and then introduced it into an atmosphere of hydrogen. The two gases completely and quietly combined in absolute darkness.—M. Prenier sent a note on "Polypropylenic Carbides." These bodies are formed by acting on propylenic bromide by nascent hydrogen; their general formula is $C^{2n}H^{2n}$.—M. J. Chaulard sent a note on the spectroscopic examination of the chlorophyll in residues of digestion. This body does not seem to be broken up in the stomach, as its absorption bands are distinctly recognisable in the excrements of animals fed on vegetables.—M. Stan. Meunier sent a note on "The increase of mechanical forces in the star (now destroyed), from whence the meteorites are derived.—M. P. Fischer sent a note on the Jurassic formations of Madagascar.—M. Pisani sent a paper on the analysis of Lanarkite from Leadhills, Scotland; he asserts that the mineral is a basic lead sulphate.—M. Chapelas's note on the aurora of January 7, was then read, and followed by a note from M. Peirce, on the levelling of the zero of the flood gauges of the Seine.—A letter from M. P. Bert to the President concerning M. Faye's recent defence of the Bureau des Longitudes was next read. M. Bert says that he did not propose the total suppression of the Bureau, but that he said that as it had not answered the expectations of science, it ought to be replaced by a bureau whose duty (like that of the "Nautical Almanac" office in England), would be to publish the *Connaissance des Temps*, and this office should receive not more than 40,000 francs (per annum?)

DIARY

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 8.30.—Contributions to the History of the Orchids: Dr. Stenhouse.—On the Fossil Mammals of Australia: Prof. Owen.—Notes on the Wide-slit Method of Viewing Solar Prominences: W. Huggins.

ROYAL SOCIETY CLUB, at 6.

ROYAL INSTITUTION, at 3.—On Oxidation: Dr. Debus.

SOCIETY OF ANTIQUARIES, at 8.30.—Implements of the Bronze Period: John Evans.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 9.—Analogies of Physical and Moral Science: Prof. Birks.

PHILOLOGICAL SOCIETY, at 8.15.

QUEKETT CLUB, at 8.

OLD CHANGE MICROSCOPICAL SOCIETY, at 8.30.—On the Senses of Insects: T. Rymer Jones

SATURDAY, JANUARY 25.

ROYAL INSTITUTION, at 3.—Comparative Politics: Dr. E. A. Freeman.

ROYAL BOTANIC SOCIETY, at 3 45.

SUNDAY, JANUARY 26.

SUNDAY LECTURE SOCIETY, at 4.—The Glacial Period; a Chapter in English Geology.—An Account of the Physical Changes which Great Britain has undergone since Tertiary Times: A. H. Green.

MONDAY, JANUARY 27.

ROYAL GEOGRAPHICAL SOCIETY, at 8 30.—Sistan. With an Account of a Journey from Bander Abbas to Meshed, through that Province: Major Gen. Sir Frederick Goldsmid.—Note on the Comparative Geography and Ethnology of Sistan: by the President.

ENTOMOLOGICAL SOCIETY, at 7.—Anniversary.

MEDICAL SOCIETY, at 8.

LONDON INSTITUTION, at 4.—Physical Geography: Prof Duncan.

TUESDAY, JANUARY 28.

ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.

CIVIL ENGINEERS, at 8.

WEDNESDAY, JANUARY 29.

LONDON INSTITUTION, at 7.—Musical Lecture.

SOCIETY OF ARTS, at 8.

BOOKS RECEIVED

ENGLISH.—The Gospel of the World's Divine Order: D. Campbell (Trübner).—Lectures on the Philosophy of Law: J. H. Stirling (Longmans).—The Botanist's Pocket-Book: W. R. Hayward (Bell & Daldy).—The School Manual of Geology. Second Edition A. J. Jukes-Browne (A. & J. Black).

PAMPHLETS RECEIVED

ENGLISH.—Scottish Naturalist, Vol. ii. No. 9.—Food Journal, Vol iii. No. 36.—American Journal of Science and Art, Nos 24, 25, for Dec. 1872 and Jan. 1873.—The Astronomical Almanack, 1873: W H. Hollis (Simpkin and Marshall).—Zoologist, No. 88.—Entomologist, No 112.—Sermons in Sonnets: W. Whale.—Proceedings of the Zoological and Acclimatisation Society of Victoria, and Report of the Annual Meeting of the Society, held March 1, 1872, Vol. i.—Fifth Annual Report of the Executive Committee of the Manchester National Society for Women's Suffrage.—Journal of the Royal Horticultural Society of London, Part 11, 12, Vol iii. 1873.—Practical Magazine, No. 1. 1873.

AMERICAN.—The Lens, Vol. i. No. 4.

FOREIGN.—Rendiconti, Vol. v. No. 19.—Bulletin de la Société Imperial des Naturalistes de Moscow.

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THURSDAY, JANUARY 30, 1873

THE INTERNATIONAL METRIC COMMISSION*

IN continuation of the previous remarks upon the proceedings of the Commission, we may now notice some of the more important scientific details of its operations.

The material for constructing the new Standards, for which an alloy of pure platinum with 10 per cent. of iridium has been selected, is obviously a matter of primary importance. Before determining upon this metallic alloy, a series of experiments was made by the French section of the Commission. A material was needed, both for the metre and the kilogramme, that should as far as possible be unalterable in its composition and molecular structure, in its form and dimensions, from the ordinary action of air, water, fire, or other chemical agents, or from mechanical forces to which it might be subject; that would in fact possess physical properties rendering it invariable with time. It should be hard, elastic, and yet not difficult to work. It should at the same time be perfectly homogeneous, so that all the Standards should be as nearly as possible identical in their material. And in order to lessen the unavoidable influences of variations of temperature, it was obvious that a material was most desirable that would experience the least alteration in its dimensions from changes of temperature. Proceeding by an exhaustive process, the Commission decided against employing any of the materials which have been hitherto adopted. Brass and alloys of copper did not satisfy the requirements, and were rejected as liable to be injuriously affected by air and heat, and from being composed of different metals varying in their density and dilatation. Quartz, though satisfactory in many respects, was too fragile and bulky; besides which there existed no prospect of obtaining it of sufficiently large dimensions and of the requisite purity. In addition to the objections attaching to quartz, glass was inadmissible by reason of the disturbing influences of moist air on its surface, and from its molecular condition as a tempered and crystallised body rendering it liable to changes from variation of temperature which might affect the constancy of its density, expansion, and even length; for it was thought that a glass metre, like a steel metre, would thus become shorter in course of time. Even platinum, which was the best pure metal for the purpose, has the disadvantage of being too soft and too weak for a measuring bar. Combined, however, with a proper proportion of iridium, platinum satisfied all the conditions required either for a Standard metre or kilogramme. These two metals have the same system of regular crystallisation, the same density and rate of expansion, and when alloyed in proper proportions, they produce a perfectly homogeneous material. They are the two metals which of all others dilate the least by heat, and the proposed alloy of 10 per cent. of iridium has been proved to have as nearly as possible the same density and the same rate of expansion as the existing Metric Standards, the *Mètre* and the *Kilogramme des Archives*. This fact alone is important as greatly facilitating the identity of the length and weight of the new Standards with those of the original prototypes of the Metric System. Platinum-iridium has also been proved to be extremely hard and rigid, and to possess the greatest elasticity, as well as cohesion or resistance to fracture. At the same time, it is easily cut with a diamond, and it has been shown that lines $\frac{8}{1000}$ of a millimetre apart (or 0·00035 inch), so cut upon it, with the aid of a microscope, are perfectly regular, even when magnified from 300 to 600 times.

The experiments of M. Regnault have shown that platinum-iridium resists the penetration of absorbent gases, and further experiments made by the Commission prove that the influence of such gases can in no way cause any change, either in its volume or its weight. A more severe test had already been applied to platinum by M. Stas at Brussels. He subjected a platinum kilogramme successively to the action of alcohol, cold water, boiling water, drying in a vacuum, and heating in a red heat of from 250° to 300° C., whilst guarded from flame; and he ascertained by comparisons in moist air, at a temperature of 15° C., with a platinum kilogramme not subjected to any of these conditions, that no change whatever had occurred in the weight of the kilogramme so treated. It was only requisite to allow a certain number of days, at most a fortnight, to elapse for the platinum to recover itself.

Another important question was that of the form to be given to the new metre. The present *Mètre des Archives* is a bar of platinum with a rectangular section, 25 millimetres wide, and 4 millimetres deep (or about 1 inch by ⅙ inch). It had been determined that the new metre, which was to be a standard *à traits*, or line-standard, should have its defining lines marked at mid-depth of the bar, on the same principle as our English standard of length, in order that the actual length of the measure should be as little as possible affected by any difference of temperature, and consequently of dilatation, between the upper and lower surfaces of the bar. But the Commission objected to the English mode of sinking cylindrical holes to the mid-depth of the bar, and tracing the defining lines on the plane surface of the bottom of these holes, as being not only inconvenient on many accounts, but also as interfering with the uniformity of structure of the bar during its whole length. The form of the new *mètre à traits* mentioned in the resolutions as having been proposed by M. Tresca, one of the secretaries of the commission, who had given much study to the question, and laid an elaborate note upon the subject before the Commission, is of a very ingenious and entirely novel character. Its transverse section may be described as taken from the form of the letter X, if divided down the middle into two halves, and then joined by a band equal in thickness to the other parts (3 millimetres). By lowering the upper surface of this band to the mid-depth of the bar, it gives a continuous plane, upon which not only the two defining lines of the metre can be cut, but also any intermediate lines that may be required as subdivisions of the metre. By a further slight reduction in the thickness of the lower half of the sectional figure, the defining lines will lie not only in the length of the neutral axis of the bar, but also in that of its centre of gravity. The dimensions of the bar itself when first constructed are to be 102 centimetres in length, and 2 centimetres square in section, and the bar is afterwards to be planed to the form decided upon. Its weight will thus be reduced to about 3¼ kilogrammes, and the defining lines of the metre will be cut at the distance of 1 centimetre from each end of the bar.

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* Continued from p. 197.

There appear to be many advantages in this new form of measuring bar, of a geometrical, mechanical, thermal, and economical character. Much importance is attached to the absolute uniformity of the bar throughout its whole length, as equalising its resistance and molecular action, and also to the adoption of a geometrical form as symmetrical as possible. The absence of any acute angle was also dwelt upon as facilitating the mechanical displacement of the surplus metal; and it has since been practically ascertained that the planing can be executed with the utmost regularity and precision. It will also prove an excellent test of the soundness of the metal throughout the whole length of the bar. The great rigidity of this form of bar, combined with the advantage of the high elasticity of the platinum-iridium, was fully shown; as compared with the rigidity of the *Mètre des Archives*, it will be as 25·9 to 1, although its sectional area is only half as much more. The new form will also be highly favourable for equalising the temperature throughout its whole length and thickness, and for taking the temperature of the surrounding medium; and it will afford a most convenient lodgement for mercurial thermometer tubes, thus enabling the actual temperature of the measuring axis of the bar to be readily and accurately determined. This measuring axis will be in one open and unbroken line, and quite unaffected in its dilatation by any contact with the support of the bar. Lastly, in an economical point of view, the form proposed will give the greatest possible strength with the least quantity of the costly material used.

This form for the *mètre à traits* can be employed with merely a slight modification for any *mètres à bouts*, or end-standards, that may be required. The form of the bars for the *mètres à bouts* will have a similar sectional figure, but symmetrical, the measure being defined by the spherical end of two small cylinders, 3 millimetres in diameter, and projecting 1 millimetre from the middle of the ends of the bar, the radius of curvature being 1 metre.

One other point may be noticed as to the mode of determining the temperature and dilatation of the standards. The temperature at which the new metre will have its true length has been decided to be the same as that of the *Mètre des Archives*, that is to say, 0° C. All the necessary arrangements have been already made for making comparisons at this temperature by constructing a cold chamber expressly for the purpose, and surrounding it with non-conducting materials. By a blast of cold air driven by a steam-engine in an adjoining room over a surface of ether and through pipes into the cold chamber, the temperature in it may be reduced in a few hours to the freezing point, and maintained constant there. From this adjoining room also the requisite light is conveyed into the cold chamber, and is thrown by reflection on the bars and apparatus. There is an inner part of the chamber in which the standard metres and the comparing apparatus are placed, whilst the observer is enabled to make the adjustments and the comparisons through the microscopes from an outer part, and thus the heat of his body is prevented from exerting any disturbing influence on the bars and apparatus.

Many comparisons of the metre will, however, be made at other temperatures, and in all such cases, as well as for ascertaining the rate of expansion of the bars, the accurate determination of the temperature by thermometers will be requisite. The question of the amount of dependence to be placed on the indication of the temperature by mercurial thermometers, which has recently been a good deal agitated in this country, was considered by the Commission to be one of great importance. They found that in all mercurial thermometers, the dilatation of the glass envelope, which, so far as it is known, is only about one-seventh that of the quicksilver, renders the reading of the best calibrated thermometers liable to errors amounting to some tenths of a centesimal degree. The best authorities are also of opinion that implicit dependence cannot be placed on the constancy of mercurial thermometers, so far as they indicate the temperature, nor on the constancy of the dilatation of the glass envelope. It was thought, therefore, that for ascertaining the temperature with a degree of precision exceeding 0°·1 C., recourse must be had to an air thermometer.

On the other hand, the air thermometer is an instrument complicated in construction and difficult to use. It requires the greatest precautions and practised skill in its manipulation; and the necessity of having recourse to an air thermometer on every occasion of making comparisons with the primary standards would create very serious embarrassments. On these grounds it was decided that every one of the new metres should be accompanied by two detached mercurial thermometers, carefully compared with an air thermometer, and which should be reverified with it from time to time.

It was stated to the Commission by M. H. Saint-Claire Deville, as the result of twenty years' use of an air thermometer, that no instrument could be more precise and convenient in reading, more easy and expeditious in use. He estimated that by employing an air thermometer according to a method suggested by him, the mean temperature of a standard metre under comparison could be determined with precision to the $\frac{1}{100}$th of a degree of the centigrade scale.

On the subject of dilatation, we can only briefly allude to M. Fizeau's admirable method of accurately determining the rate of expansion of solid bodies by heat, by employing the length of a wave of monochromatic sodium light (a constant = 0·005888 millimetre, or 0·00002318 inch), as his standard of measure. By means of an ingenious apparatus constructed by M. Soleil, the yellow ray is made to fall vertically through a piece of plate glass on a horizontal plane of the solid body, and is reflected in the under-surface of the glass. By counting the number of Newton's rings passing a fixed point upon the glass, when they are set in motion from the expansion of the surface of the solid body by observed degrees of heat, its dilatation can be computed with the greatest precision. This method has been described in the proceedings of the Royal Society on November 30, 1866, when the Rumford gold medal was awarded to M. Fizeau for it. The Commission also hope to obtain a standard of dilatation by marking a measure of length of one or two decimetres upon the plane surface of a piece of Beryl in its axis of non-dilatation. M. Fizeau has shown that Beryl varies in its dimensions from heat less than almost any other body, and that it possesses this peculiarity, that whilst it expands by heat in the direction of its axis of crystallisation, it contracts by heat in the direction perpendicular to this axis; consequently in the line of the proper intermediate angle there is no dilatation or contraction whatever from heat. Endeavours will therefore be made thus to obtain an invariable standard measure of length, by comparison with which the rate of dilatation of measures variable with heat may be determined.

There are other subjects of the investigations of the committee which might be noticed, but we have probably stated enough to enable some idea to be formed of the magnitude of the work undertaken by the International Metric Commission, and of the value and importance of the anticipated results of their labours; as well as the advantages expected to be obtained from the proposed establishment of the permanent International Metric Institution. H. W. CHISHOLM

DE MORGAN'S BUDGET OF PARADOXES

A Budget of Paradoxes. By A. De Morgan. (Longmans, 1872.)

THIS work is absolutely unique. Nothing in the slightest degree approaching it in its wonderful combinations has ever, to our knowledge, been produced. True and false science, theological, logical, metaphysical, physical, mathematical, &c., are interwoven in its pages in the most fantastic manner: and the author himself mingles with his puppets, showing off their peculiarities, posing them, helping them when diffident, restraining them when noisy, and even occasionally presenting himself as one of their number. All is done in the most perfect good-humour, so that the only incongruities we are sensible of are the sometimes savage remarks which several of his pet bears make about their dancing-master.

De Morgan was a man of extraordinary information. We use the word advisedly as including all that is meant by the several terms knowledge, science, erudition, &c. Everywhere he was thoroughly at home. An old edition and its value-giving peculiarities or defects, a complex mathematical formula with its proof and its congeners, a debated point in theology or logic, a quotation from some almost-unheard-of author, all came naturally to him, and from him. With a lively and ready wit, a singularly happy style, and admirable temper, he was exactly fitted to write a work like this. And every page of it shows that he thoroughly enjoyed his task. Witness, for instance, the following extract:—

> "I will not, from henceforward, talk to any squarer of the circle, trisector of the angle, duplicator of the cube, constructor of perpetual motion, subverter of gravitation, stagnator of the earth, builder of the universe, &c. I will receive any writings or books which require no answer, and read them when I please: I will certainly preserve them—this list may be enlarged at some future time. There are three subjects which I have hardly anything upon: astrology, mechanism, and the infallible way of winning at play. I have never cared to preserve astrology. The mechanists make models, and not books. The infallible winners—though I have seen a few—think their secret too valuable, and prefer *mutare quadrata rotundis*—to turn dice into coin—at the gaming-house; verily they have their reward."

He was not, let it be at once said, a great original mathematician—not, that is, of the order of men like Boole or Rowan Hamilton—but extraordinarily great mathematicians like these are very rare, and there were not in Britain a dozen who were his superiors. We are told in the Preface to this work that it was his intention to have composed a companion volume on "the contradictions and inconsistencies of orthodox learning." What a loss we have here sustained—how narrow an escape several of our most popularly idolised men of science, &c., have made—must be known to many, perhaps even dimly suspected (at least we hope so) by those who would assuredly have been the earliest and most prominent sufferers.

A great part of the volume consists of reprints from a series of almost weekly papers in the *Athenæum*; but much new matter has been added, and several modifications and corrections have been made. The task of editing has been undertaken by the author's widow, and appears to have been exceedingly well done throughout. The volume is not one which can be read through at a sitting—nor even at three or four: the multiplicity of subjects renders it bewildering if more than a dozen or two of pages be read at a time—but we do not envy the man who cannot, at a spare moment, find both pleasure and profit in the perusal of a moderate portion of it, taken *ad aperturam*.

De Morgan was a very dangerous antagonist. Ever ready, almost always thoroughly well informed, gifted with admirable powers of sarcasm which varied their method according to the temperament of his adversary, he was ready for all comers, gaily tilted against many so-called celebrities; and—upset them. It is unfortunate that the issue of his grand contest with Sir William Hamilton (the great Scottish Oxford Philosopher) is but in part indicated in this volume—it is softened down, in fact, till one can hardly recognise the features of the extraordinary *Athenæum* correspondence of 1847. There the ungovernable rage of the philosopher contrasts most strongly with the calm sarcasm of the mathematician, who was at every point his master, and who "played" him with the dexterity and the tenderness of old Isaak himself! But it is characteristic of De Morgan that, though he was grievously insulted throughout the greater part of this discussion, no trace of annoyance seems to have remained with him after the death of his antagonist; for none would gather from the "Budget" more than the faintest inkling of the amount of provocation he received.

Yet De Morgan had his weak points, and in an unguarded moment he made a first, and last, attack—one of the few assaults in which he was unsuccessful—on Faraday. At least he gets the credit of having reviewed a lecture of Faraday's in the *Athenæum* of 1857, and of having for once wholly missed the main point at issue.

To return to the "Budget." The tenderness displayed for trisectors, duplicators of the cube, circle squarers, perpetual motionists, *et hoc genus omne*—from J. Reddie through J. Symons, to J. Smith—is most touching. The real human interest evidently taken in the careers of those hopelessly ignorant writers, does credit to De Morgan's heart. He does not hang up his Paradoxer on high as a warning, nor does he dissect him for purposes of psychological study; he carefully spreads him out, under sufficient but not extravagant pressure, on the white page of his herbarium, and fondly preserves him as a specimen for his future lectures. Thus the specimens may be said to *live* in his pages, with all their bright motley of colour and their extraordinary odours—only *flattened* a little by the supreme necessities of the case.

Mingled with the paradoxes, and generally more or less directly suggested by them, we have many valuable pieces of information—as, for instance, about the calendar (pp. 219, &c.), the names of the "beast" (p. 403), the "Macclesfield Letters" (p. 448), &c.—and we have anecdotes, verses more or less confessedly doggrel, and paradoxes full-blown, from the author's own pen.

One extract must suffice, though there are hundreds equally good, for which we must refer the reader to this most thoroughly enjoyable book itself. Our choice is determined by the present aspect of the education question: and conveys a much-needed lesson to all who are capable of comprehending.

"It was somewhat more than twenty years after I had thus heard a Cambridge tutor show sense of the true place of Horner's method, that a pupil of mine who had passed on to Cambridge was desired by his College tutor to solve a certain cubic equation—one of an integer root of two figures. In a minute the work and answer were presented by Horner's method. 'How!' said the tutor, 'this can't be, you know.' 'There is the answer, sir,' said my pupil, greatly amused, for my pupils learnt not only Horner's method, but the estimation it held at Cambridge. 'Yes,' said the tutor, 'there is the answer, certainly; but it *stands to reason* that a cubic equation cannot be solved in this space.' He then sat down, went through a process about ten times as long, and then said with triumph, 'There! that is the way to solve a cubic equation!' I think the tutor in this case was never matched, except by the country organist. A master of the instrument went into the organ-loft during service, and asked the organist to let him *play the congregation out*; consent was given. The stranger, when the time came, began a voluntary, which made the people open their ears, and wonder who had got into the loft; they kept their places to enjoy the treat. When the organist saw this, he pushed the interloper off the stool, with 'You'll never play 'em out this side Christmas.' He then began his own drone, and the congregation began to move quietly away. 'There!' said he, 'that's the way to play 'em out!'"

BURMEISTER'S ANNALS OF THE PUBLIC MUSEUM OF BUENOS AYRES

Anales del Museo Publico de Buenos Ayres, para dar a conocer los objetos de Historia Natural nuevos o poco conocidos conservados en este establecimento. Por German Burmeister, M.D. Vol. ii., parts 1—4. (Buenos Ayres and London: Taylor and Francis.)

IN a previous number of NATURE (vol. iii. p. 282), Prof. Flower has given our readers an account of the first volume of this most meritorious work, and of the objects of its distinguished author in undertaking it. Since Prof. Flowers's article was published, four parts of the second volume of the "Anales" have been issued, containing a series of articles and illustrations of quite as great zoological interest as those in the first volume. The wonders of the extinct Mammalian Fauna of the Argentine Republic are well known, and in the present volume Prof. Burmeister devotes himself to their exposition. In the first part he commences a complete monograph of the Glyptodonts, or extinct gigantic Armadillos, represented by specimens in the museum under his charge, and carries it on to the end of Part IV. In the first volume of the "Annals" Prof. Burmeister, in the course of a general article on the fossil mammals of the diluvium of Buenos Ayres, had given a preliminary exposition of his views as to the arrangement of these wonderful animals. He now enters at length upon the description of the species known to him, and gives a series of splendid lithographs to illustrate their remains. Not only are the bones of the Glyptodonts so perfectly preserved as to enable many of the skeletons to be completely restored, but great portions of the extraordinary suits of armour with which they were clad above and below have likewise been discovered, so that their external appearance can likewise be portrayed. Those who interest themselves in palæontology will do well to secure copies of these beautiful illustrations, a few of which are on sale at Messrs. Taylor and Francis, of Red Lion Court, at 10*s.* a number.

We should add that, attached to each number of the "Anales" is a "Boletin del Museo Publico de Buenos Ayres," in which is given an account of the additions made to the establishment during the year. An important acquisition in 1871 was the series of remains of the *Machrauchenia patachonica*, an extinct animal allied to the horses and tapirs, formerly belonging to a naturalist named Bravard, who was killed in the earthquake of Mendoza. These specimens formed the basis of Prof. Burmeister's complete restoration of this animal, published in the first volume of the "Anales."

OUR BOOK SHELF

Notes on the Post-pliocene Geology of Canada, &c. By J. W. Dawson, LL.D., F.R.S., F.G.S. (Montreal: Mitchell and Wilson, 1872.)

THESE "Notes," which are reprinted from the *Canadian Naturalist*, cannot fail to interest European glacialists. Especially valuable for purposes of comparison are the detailed notes on the fossils obtained from the glacial beds. The lists include in all about 205 species, distributed as follows:—Radiata, 24; Mollusca, 140; Articulata, 26; Vertebrata, 5. All these, with three or four exceptions, may be affirmed, says the author, to be living northern or southern species. Moreover, the fauna of the older part of the Canadian glacial deposits is more Arctic in character than that of the modern part. It would thus appear that since the accumulation of the boulder-clay a gradual amelioration of climate has taken place; but the change from Arctic conditions has evidently been less decided on the west than on the east side of the Atlantic. Dr. Dawson's conclusions regarding what we may term the physics of the glacial epoch will probably meet with less acceptance than his palæontological results. He considers the Erie-clay described by Whittlesey, Newberry, and others to be of marine, and not of fresh-water origin, as these authors believe. But his reasons for this opinion can hardly be considered satisfactory. When an extensive deposit of fine clay, after having been examined over a wide area, is found not only to be totally destitute of marine organisms, but to contain quantities of drift-wood, and to have associated with it beds of peat and an old soil containing tree roots, the probabilities are that the clay-beds are of fresh-water origin. Besides, if we are not mistaken, fresh-water shells have been got in the Erie clay. That much-vexed question, the origin of boulder-clay comes in for some discussion in these "Notes," the author inclining to think the deposit is marine. It is somewhat significant, however, that the boulder-clay is only fossiliferous in the lower part of the St. Lawrence river; further inland it has not been observed to contain fossils. From the author's description of the boulder-clay as seen at low levels in Canada, we think that deposit more closely resembles some of the maritime fossiliferous stony clays of Britain than our Till or lower boulder-clay. Dr. Dawson seems to have satisfied himself that the "real cause" of the excavation of the American lakes "was obviously the flowing of cold currents over the American land during its submergence." He also thinks that "the fiords on coasts, like the deep lateral valleys of mountains, are evidences of the action of waves, rather than that of ice." No glacialist, as far as we know, holds the extravagant belief that fiords have been cut out by ice. They are undoubtedly submerged valleys, and were hollowed out by streams and other atmospheric influences in ages long anterior to the glacial epoch. But however much we may differ from Dr. Dawson in some of his conclusions, there can be no doubt that he has added very considerably to our knowledge of American glacial deposits, and we cordially recommend the perusal of his "Notes" to our geological readers.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Invention of the Water-Air-Pump

STATEMENT BY PROF. BUNSEN [*]

"A letter addressed to me by Dr. Sprengel, under date of November 1, 1872, in which he says: 'Perhaps it will not have escaped your observation, that the invention of the water-air-pump, which you have constructed after the principle of my mercury air-pump, according to your paper published in 1868 on the washing of precipitates, is almost everywhere attributed to you,' induces me to make the following statement:

"The interesting discovery, that by means of columns of liquids flowing downwards a more perfect vacuum can be produced, than was possible by the air-pumps hitherto in use, belongs solely and only to Dr. Sprengel. He in his researches on the vacuum (*Journal of the Chemical Society*, January 1865) brings prominently forward, that water is from a practical point of view the only liquid which could come into consideration as a substitute for mercury used in the instrument described by him; and that it is not unlikely that such an instrument, adapted for water, might possess advantages which air-pumps of other constructions have not, particularly in hilly countries, where the large volume of a natural waterfall might be rendered available. In the theoretical considerations on the action of his instrument, which immediately follows the above, it is noticed, that it is simply the reverse of the Trompe, with this addition, that the supply of air is limited, while that in the Trompe is unlimited.

"If in the face of these facts, which are open to all, anyone attributes to me, as I must conclude from Dr. Sprengel's letter, a share in his discovery, I can regret this only all the more keenly, as in my treatise on the new method of filtration I could not possibly have expressed myself with regard to Dr. Sprengel's claims more loyally and precisely than I have done. There, I have stated expressly, that I have constructed the pump used for filtrations and described by me in detail, after the principle of Sprengel's mercury-air-pump. It was the only apparatus of the kind which Dr. Sprengel described, consequently the one to which alone I could refer. "R. BUNSEN

"Heidelberg, Nov. 5, 1872"

Expressing my best thanks to Prof. Bunsen for the above statement, I beg to add, that since 1860 I have been using for laboratory purposes a water-trompe. as described by me in *Poggendorff's Annalen* for 1861, vol. cxii., which (by reversing the action) led me in 1863 to the new method of air-rarefaction. Water was the first liquid, which I used in my first pump, constructed during the summer of 1863. But the fallacies arising from the tension of aqueous vapour and from the air absorbed in water, as well as the inconvenience of having to provide for the requisite fall, caused me to discontinue the use of water, and to substitute in its stead mercury as the most suitable liquid for establishing *the* truth, which I had recognised by means of a water-air-pump with an insufficient fall. My paper of 1865 was written with reference to *all* liquids; in fact, on p. 15 (rendered prominent by italics) I summed up thus:—

"The main fact which I have established in this paper may be shortly stated to be that, *if a liquid be allowed to run down a tube, to the upper part of which a receiver is attached by means of a lateral tube, and if the height at which the receiver is attached be not less than that of the column of the liquid which can be supported by the atmospheric pressure, a vacuum will be formed in the receiver* minus *the tension of the liquid employed.*"

I regret that the obviousness of the matter led me to refrain from expressing myself in a more detailed manner, believing, as I still believe, that what I wrote sufficiently described the construction of the water-air-pump.

In conclusion Mr. Johnson's aspirator [*] for establishing a current of air ought to be mentioned here. It was recognised by Prof. Hofmann [†] to act on the principle of the trompe, and of course might have served as an air-pump, had it been noticed at the time that the instrument would furnish the means of creating a vacuum. And I may also draw attention to the tube [‡] of a vacuum-pan, through which the water is made to escape, which has served to condense the steam of the boiling liquid. This no doubt would in like manner have served as a complete water-air-pump, but it does not appear that its use as such was discovered. H. SPRENGEL

London, Jan. 22, 1873

Kant on the Retarded Rotation of Planets and Satellites

IT is now recognised that the tides are necessarily lengthening the day; but the history of this recognition seems to be incomplete. "It appears," says Mr. Tait in his "Thermodynamics," p. 86, "that the first suggestion of such an effect is due to Kant." Mr. Stewart speaks more positively ("On Heat," p. 356), but adds that Mayer "was the first to give his conclusions general publicity."

The following are the facts with respect to Kant, as they are to be found in Rosenkranz and Schubert's edition of his works, part vi. pp. vii. 3-12. The Berlin Academy of Sciences had proposed, as the subject of a prize essay for 1754, the questions whether the length of day and night had changed, and if so, what the cause could be and how this was to be ascertained. Kant did not compete; apparently he was dissatisfied, as well he might be, with his attempt to estimate the possible amount of retardation; but he published his views in a Königsberg weekly paper.

It is of some interest to compare Kant's position with our own. In the first place, he expresses himself with almost entire generality. He does not speak merely of the tides, but says that the rotation of any planet is necessarily retarded if it contains a considerable amount of fluid. Kant knew as well as we do that the *considerableness* (that is the magnitude) of the cause affected only the magnitude (and not the bare reality) of the effect; so there is nothing to be added to his statement of the condition of retardation but what our own writers do not seem to think worth adding, namely the energy dissipated in consequence of the imperfect rigidity and elasticity of the solid parts of the planet.

Again, with respect to the final result, Kant makes two statements, which, if literally contradictory, yet taken together go to show the fulness of his knowledge. First he says the rotation must ultimately cease; further on that it must diminish till it is equal to the revolution of the moon, so that the earth will constantly face the moon, as the moon now constantly faces the earth. The essay bears marks of hasty writing; and it seems clear that the latter statement is only intended for that part of the effect which is due to the moon. The former may be intended to affirm the ultimate abolition of the solar day; if it means much more (as it ought) I presume it is inconsistent with Kant's express rejection of the hypothesis of an interplanetary resisting medium.

On the other hand, Kant betrays no suspicion of the reaction upon the disturbing bodies, and the consequent lengthening of the month and year. And in speculating on the possibility of historical verification, he thinks only of an apparent shortening of the year, forgetting the month, which, as it has turned out, has proved the tell-tale. Least of all can he have imagined that the question could be answered, or even asked—What becomes of the lost velocity?

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[*] Translated from *Ann. Chem. Pharm.* vol. clxv. p. 159, by H. Sprengel, authorised by Prof. Bunsen.

[*] *Quarterly Journal of the Chemical Society*, vol. iv. p. 186. 1852.

[†] Ibid.

[‡] "Elements of Physics," by Neil Arnott, M.D. (Longmans.) 3rd edit. London, 1828.

But he says expressly that it is probably the tidal influence of the earth that has brought the moon to face the earth constantly as it does. Mr. Tait, in the passage from which I have quoted, treats this suggestion as originally Helmholtz's, though, speaking under correction, I should have said it formed part of Laplace's explanation. Be this as it may, Kant published it when Laplace was five years old.

The essay was reprinted by Nicolovius in his collection of Kant's minor pieces. I do not know the date of this publication, but 1839 is the date of Rosenkranz and Schubert. Yet we have Arago in his latest work, and Herschel at least as late as 1851, affirming the invariable length of the day, not merely as approximately established by history, but (internal disturbance apart) as a direct result of dynamical principles. It is not "general publicity" that was wanting in Kant's case, but special publicity, the publicity of Transactions and Jahrbücher. It is to be hoped that those who work in the several departments of knowledge are now learning to know better what their neighbours are about.

Hadley, Middlesex, Jan. 21 C. J. MONRO

Pollen-eaters

I AM sorry that I am unable to give Mr. Bennett all the information that he desires, as I have never studied the classification of the Diptera, and do not know the species of the flies in question; nor do I like to trust my memory as to those of the flowers. The common dandelion is, however, I think, an especial favourite; and it is evident that in this and other Compositæ the movements of any insect among the flowrets must scatter some of the pollen upon the stigmas, and some may even be carried on its legs and body in its wanderings from flower to flower, though the smooth body and cleanly habits of the fly must be rather an obstacle to this. But to some other species of flowers, on the pollen of which I have sometimes seen them feeding, and paid particular attention to this point, I think it very doubtful whether their visits can be anything but injurious.

W. E. HART

P.S.—Allow me to correct a misprint in my former note. By the substitution of an "N" for the initial "h," the expressive popular name of "hoverers," which I used in writing of the *Syrphidæ*, has been rendered quite meaningless I should also be glad to know whether I am correct in the use of the word "mandibula," in the same note.

Meteors in South Pacific

WHILE some natives of these islands were preparing my boat for a journey during the night of October 27–28, they were considerably alarmed by the appearance of a very large meteor. As far as I could ascertain from them it became visible near to ζ Ceti, and rushed towards the south-east, leaving a bright train in its wake. One of the natives described it as being as large as a man's head; the others thought it was larger than that. These statements about size must be taken with caution, but from the excitement it caused I believe the meteor was a very large one. It was seen a little before local midnight.

I was travelling the same night from midnight to 3 A.M., and during that time I observed eleven meteors: two of which appeared near to Pollux, and disappeared near to α Hydræ. The other nine all appeared near to η Canis majoris and proceeded through the constellation Argo Navis. The last I saw, at 3 A.M., reached nearly to the Southern Cross, which was then just above the horizon.

Only one of the eleven meteors I saw was at all remarkable for size, and that was about as bright as Sirius, with which I compared it. This was the only one which left any perceptible train.

I should add that, although Samoa is in the Western hemisphere, our local time is that of the Eastern hemisphere; hence the dates given are twenty-four hours ahead of the true time of our geographical position. S. J. WHITMEE

Samoa, South Pacific, Oct. 30, 1872

Aurora Spectra.

MR. CAPRON'S notice of my observations with regard to the auroral spectra compels me to say a few words with regard to them which I should rather have deferred till I could confirm my suspicions by fresh experiments. The spectrum which appears to coincide with the aurora, is not the ordinary spectrum of oxygen obtained by the disruptive discharge, but is, I have little doubt, that described by Wällner (Phil. Mag. p. 420, vol. xxxvii.) It is not uncommon in ordinary *lumière* tubes, but I obtained it with a feeble discharge in tubes filled with electrolytic oxygen, and therefore put it down to that gas. It is now two years since I made these experiments. Circumstances compelled me to leave the research incomplete, and I have hitherto been unable to return to it; but greater experience in the difficulties of spectrum work has suggested sources of error which I did not then suspect, and I should not feel any surprise if the spectrum in question turned out to be that of some carbon compound from the india rubber connections. It certainly has a strong family likeness to these, and if it were so, would confirm Prof. Piazzi Smyth's coincidence with citron acetylene. I will endeavour shortly to decide this.

As to instrumental power, the greatest I have used on the aurora has been that of a 60° bisulphide prism; but this is sufficient to show in both lines a breadth distinctly greater than the slit. Unfortunately, however, as I think I have before stated, the auroral line appears equally nebulous on both sides, while that in the tube spectrum is shaded mainly towards the red. On the other hand it is fair to note that this ceases to be visible when the light is faint and the dispersive power not greater than that employed on the aurora.

North Shields, Jan. 18 HENRY R. PROCTER

On the Words "Diathermanous," "Diathermancy," etc.

IN reply to the question of Mr. W. M. Williams in the postscript to his letter (NATURE, vol. vii. p. 202) I beg leave to make a few observations. I presume that the author of the above terms thought that the idea of the permeability of a medium by radiant heat could be better expressed by derivatives of the verb θερμαίνω (I heat) than by those of the more elementary words θέρμος (hot) or θέρμη (heat). To the former of these classes "diathermanous," "diathermancy" (from θερμανσις), and "diathermacy" (from θερμασία), all belong, though they are not very regularly formed, as our English termination "cy" corresponds to the Latin *tia*, as "clemency" from *clementia*, or the Greek "τεια," as "policy," from πολιτεία. "Diathermous" belongs to the latter class.

According to precedents the substantive corresponding to "diathermous" might be "diathermy," as bigamous, bigamy, or "diathermeity," as diaphanous, diaphaneity, or "diathermosity," as porous, porosity, but not "diatherm*acy*," in which the second letter "a" clearly points out its derivation from the verb.

In point of form the words of Latin origin, "transcalent," "transcalency," which have been used in the same sense, are quite unobjectionable, and have the great advantage of corresponding in form with "transparent," "transparency," "translucent," "translucency," so that the words expressing permeability by the rays of light and heat are of similar form, though perhaps the derivation of "calescence" from a neuter verb, when an active sense is wanted, may be an objection to their use.

Seeing, therefore, that "diathermous" has no very eligible substantive corresponding to it, I submit that the original words "diathermanous" and "diathermancy" are most eligible in sense and least objectionable in form of the words of Greek derivation. Some perhaps, in spite of the above objection, may prefer the Latin words. W. D. L. L.

Dr. Sanderson's Experiments

MAY I ask Dr. Burdon Sanderson to kindly state in your columns one or two matters relating to the cheese employed by Dr. Bastian in the experiments at which he assisted. He justly remarks on the value of a knowledge of methods of demonstrating important facts—and I would therefore ask for the advantage of other readers as well as my own—some further information. I have already to thank Dr. Bastian for stating the specific gravity of his turnip-solution, in reply to my request.

In Dr. Sanderson's letter additional particulars are given, which also do not form part of the statement of those conditions under which Dr Bastian tells us in his book on the "Beginnings of Life," that he has in the proportion of 999 cases out of 1,000 obtained a development of Bacteria from turnip-solution—boiled and sealed boiling. It appears that Dr. Bastian considers it a condition favourable to success—that the rind of the turnip be excluded from the preparation of the infusion. This is for the first time announced in Dr. Sanderson's letter. Also it is there for the first time that an accurate description of the flasks (not tubes) used, and of the quantity of infusion enclosed in each flask is given.

I now merely desire to know the quality of the small quantity of pounded cheese added to each flask. Let me say that another condition of the experiment—not given by Dr. Bastian, but now for the first time by Dr. Sanderson, is the addition of the cheese after the infusion is in the flask—so that no straining or filtration is made use of, subsequently to its addition. In the absence of so distinct a statement on this point as that of Dr. Sanderson, it was natural to suppose that the turnip and cheese infusion would be strained in some way, to get rid of coarse particles. It seems important that it should be known (1) what kind of cheese was used, (2) about how much to each fluid ounce of turnip infusion, (3) to what extent the cheese was "pounded" before addition, and whether particles of cheese visible to the naked eye, and of what approximate size, were present in the infusion during its boiling? (4) whether the turnip solution was strained before the addition of the cheese, and whether it contained obvious solid particles, and of what size?

I trust that Dr. Sanderson having placed your readers, and those interested in the natural history of Bacteria, under so great an obligation by his careful statement of the conditions of the experiments of which he was witness, will kindly add to our debt by furnishing this additional information.

In numerous experiments with turnip solution made by Dr. Pode and myself recently in the laboratory of the Regius Professor of Medicine of this University, we found that under the conditions given in Dr. Bastian's book, no life was developed—a result contrary to that obtained by him in 999 cases out of 1,000. It will be necessary to make further experiments by aid of the light furnished by Dr. Sanderson's letter, in order to explain this discrepancy.

It is desirable to call to mind that Pasteur himself and others have recorded experiments regarded by them as demonstrating the survival of the Butyric form of Bacterium or its germs, after exposure to temperatures of 100° or even 105° C.

Exeter College, Oxford E. Ray Lankester

THE NATIONAL HERBARIA MEMORIAL

We are glad to be able to lay before our readers the reply to the memorial to Mr. Gladstone, signed by so many eminent botanists, which appeared in Nature for January 16. The answer is in every respect satisfactory:—

"Treasury Chambers, January 23, 1873

"Sir,—The Lords Commissioners of Her Majesty's Treasury have had before them your letter of the 3rd instant, and the Memorial enclosed in it from various gentlemen engaged in the pursuit of botany or in instruction therein, with respect to the transfer to the branch of the British Museum about to be constructed at South Kensington, of the scientific collections and library now existing at the Royal Gardens at Kew.

"Their lordships desire me to request that you will inform the memorialists that Her Majesty's Government have not formed the intention of removing the collection to South Kensington, and that should anything lead them hereafter to entertain the idea, they will take care that ample notice shall be given, and that the judgment of the persons most accomplished in botany shall be fairly weighed in the first instance.

"I am, Sir, your obedient servant,
"William Law

"The Rev. M. J. Berkeley, Sibbertoft,
"Market Harborough"

THE METEOROLOGICAL OBSERVATORY AT MAURITIUS

The Meteorological Society of Mauritius have recently presented to the Governor of that colony a memorial (contained in a copy of the *Commercial Gazette* sent to us) requesting him immediately to place on the estimates a sum sufficient to complete the new meteorological observatory there before the end of the present year. One of the objects for which this excellent society was formed in 1851, was to aim at the establishment of a permanent meteorological and magnetical observatory; and since 1860 the members have been doing their best to urge the Colonial Government to help them to accomplish their object; but one untoward event after another has occurred to postpone its consummation. The old observatory, a very inconvenient one, was sold in 1866 for 10,843*l.* and about half this sum was made available by the Government for the new observatory and instruments; besides this, another sum of 4,500*l.* is available, though the Government hesitate to make use of it. In 1870 a small portion of the new building was erected, and the foundation stone of the main building laid by H.R.H. the Duke of Edinburgh, but nothing more has been done since; and the staff, owing to the scanty allowance for the purpose, has been utterly inadequate. The memorial then asks the governor to grant at once the funds necessary to complete the building and to maintain an adequate staff; and urges, as a reason for haste, among other more enduring and general reasons, the approaching transit of Venus. The people of Mauritius, both for their own sakes and for the sake of science, the Society believe will be glad to lend a helping hand. We cannot but think that if the Government of Mauritius give the matter their serious consideration, they will at once accede to the prayer of the society's memorial. The benefit which such an observatory, in the heart of the Indian Ocean, would confer on science and humanity would be immense: and to cripple such an institution would be anything but economy. The vast importance in agricultural, nautical, and sanitary points of view, of having an observatory in Mauritius, is generally acknowledged; indeed, it is well known to those who have resided in Mauritius, as well as in other tropical countries, that timely warning of a single hurricane (which experience shows can be given), might save as much money as would suffice to build an observatory, and to maintain it for years. The Society does not seek any help from the Imperial Government; and we sincerely hope that no narrow and short-sighted notions of economy will prevent the Governor of Mauritius from at once granting the means of fulfilling the so frequently frustrated hopes of the Meteorological Society.

The Society concludes its memorial by "strongly recommending that no deviation should be made from the plan proposed by the President and Council of the Royal Society of London; that is, that meteorological, magnetical, and solar spot observations should be carried on simultaneously by photography. To endeavour to carry out a half-measure, liable to change and interruption, would be almost a waste of time and money. It is probable that meteorology, terrestrial magnetism, and sunspots, are intimately connected by some law or laws not yet determined; and nothing short of long-continued photographic records of the several phenomena concerned, would meet the present requirements of Science."

THE NATIONAL HERBARIA

The Memorial printed in Nature for January 16 will probably be held to be a sufficient indication of the estimation in which Kew is held as a scientific establishment by the botanists of the country as well as of the undesirableness in their opinion of its being in any way dismembered.

It will not I hope be considered improper if I venture (entirely, of course, on my own responsibility), to make some remarks with the view of aiding those who are not botanists to form an opinion upon the matter.

In the first place it may be well to give some notion of the nature of a public herbarium and the purposes it serves. Most persons are aware that with a little care specimens of almost any plant can be dried under pressure, so as to give, even to those who are not accustomed to study such specimens, some notion of what the plant is like in the fresh state. To a professed botanist they yield of course a great deal more information.

A herbarium then consists of a collection of dried plants. Whatever may be the plan adopted by private individuals, it is absolutely necessary in a public herbarium that the specimens should be securely stuck down upon sheets of paper, in order that they may bear frequent handling without injury. This does not, however, prevent the detachment under proper supervision of such fragments as can be spared and are requisite for scientific investigation. The sheets on which the specimens are fastened are placed in loose covers, and these are arranged in proper classificatory order on the shelves of cabinets which are made to hold them.

Any botanist interested in any particular group of plants, and visiting a well-worked herbarium, has only to go to the proper place to find everything that the herbarium contains belonging to that group ready to his hand, and in a state suitable for study. Such a result is not, however, attained without immense labour on the part of those who have charge of the herbarium. Fresh accessions of plants have continually to be examined in detail before the proper positions for their intercalation in the arranged collection can be determined.

A public herbarium derives its additions from three sources:—gifts, exchange, and purchase. The first includes, besides collections given by the government departments, at whose instance they have been made, supplies coming from private individuals. At Kew the Garden and the Herbarium benefit in common by the extensive correspondence carried on in every part of the globe with persons of every grade. Contributions, both large and small, are constantly arriving of living and dried plants, seeds, and specimens unsuitable for herbarium purposes but which find their place in the Museums. This correspondence it has required a long period to organise, and it needs no small exertion to continue and extend it. I conceive that it is, putting aside all others, a very strong argument for the maintenance of a herbarium at Kew, that it participates, as no other herbarium in this country could do, in the results of a correspondence which must necessarily be kept up for the purposes of the Garden, and which indeed could hardly be carried on elsewhere for the advantage of a herbarium alone, to anything like the same extent. Moreover the correspondents of Kew constantly send dried plants to be named, besides making demands for every kind of information which nothing but a herbarium and library on the spot could enable them to be supplied with.

The dried plants which are received at Kew from different sources necessarily include a large number of duplicates, that is, of specimens not needed for the herbarium. These, however, are not wasted, but are sent from Kew to various establishments with which exchanges can be effected. This is a most important matter, because the authentically named specimens of foreign botanists which are received in exchange are far more useful for purposes of comparison than any figures or descriptions.

The uses of a large herbarium are in the main two. In the first place it supplies the material for purely scientific investigations, both with regard to the structure and classification of plants as well as with regard to their geographical relations and the problem of how their world distribution has come to be what it is. But a herbarium is also most important on purely utilitarian grounds. An immense number of important products are derived from the vegetable kingdom, and it is very necessary to have exact and precise information as to the plants which produce these. Dried plants preserved in herbaria are standards of reference in comparison with which the names of specimens can be accurately determined. Botanical names have a universal currency, and therefore obviate all the divergencies and confusion of those which are merely local and vernacular. Horticulturists moreover look to those who have access to herbaria to guarantee the correctness of the nomenclature of garden plants.

Besides the herbarium at Kew there is the older one belonging to the British Museum. It is still in a measure *sub judice* what is to be the future position of these two institutions. That the Kew Herbarium should not be severed from the Garden is the all but unanimous judgment of those who are best qualified to give an opinion. With respect to the British Museum Herbarium there is greater difference. Some botanists have wished to see the valuable type specimens which it contains added to those at Kew, just as they might wish, if it were in their power, to condense there what is best in some of the leading foreign herbaria. In my opinion the transference to Kew of any portion of the British Museum collections would be very undesirable. The British Museum specimens are mounted on paper of a very different size, and the sheets could not be cut down without impairing their authenticity. Moreover, at the British Museum there is an extensive series of ante-Linnean herbaria most valuable from a historical point of view, but not otherwise available for study, and these would, on that account, be out of place at Kew. Again, with collections so combustible as those of dried plants, it is all but imperative to divide the risk of losing the whole national accumulations in one conflagration.

The two Herbaria have also two well-marked but distinct fields of activity open to them. Let the Kew Herbarium remain, as at present, to be used for the varied ends of the Kew establishment, and by such students as are engaged in important works, as original memoirs and colonial or forest floras executed for the Government. They would be willing to gain, as they do now by the distance from town, tranquillity from the incursion of visitors less permanently occupied with botanical pursuits. Then the British Museum collections (which, if it were possible, it would be a convenient arrangement to retain in Bloomsbury) would serve still for persons who would use them rather for reference than for continuous study, although this also would not be precluded. It must, however, be admitted that they are capable of very great improvement even for purposes of reference, and it would be very desirable to this end that the Kew and Bloomsbury establishments should be brought into some sort of amicable relation. I will give a few instances quite arbitrarily selected from my own experience, which will show how very far behind the British Museum Herbarium is in completeness to that of Kew.

The Indo-Malayan genus *Dipterocarpus* is represented in the former by 17 sheets, including 10 species, in the latter by 116 sheets, including 31 species; the South African genus *Stapelia*, consisting of plants very difficult to dry, in the former by 4 sheets of 3 species, in the latter by 48 sheets of 25 species; lastly the Tasmanian *Athrotaxis* (*Coniferæ*), of which one species is to be found in nurserymen's catalogues, is represented at Kew by 16 sheets, illustrating all the three known species; while at the British Museum I have not succeeded in discovering a single specimen in the arranged collection at all.

But a very large portion of the plants at the British Museum are practically inaccessible. Unfastened on paper, and much in the state in which they were received from the collectors, except a rough geographical distribution into cupboards, they are little more assorted than the plants which constitute a haystack. A considerable part, if not the whole, of the 7,000 specimens of plants from the expeditions of Hooker and Thomson, which cannot have been received less than fifteen years ago, were, quite lately, still unmounted and unincorporated. Again, merely to quote instances which have come unsought within my own observation, the plants collected in Nepaul half a century since by Wallich, and as I learn from a distinguished Indian botanist, in a district which has never since been botanically explored, were recently, and perhaps are still, amongst the unarranged collections. These altogether, I should judge, roughly form in bulk about one-sixth of the whole herbarium. The arranged portion is estimated to possess 77,400 species of flowering plants, contained in 306 cabinets with 8 shelves; the Kew Herbarium, on the other hand, possesses 105,000 to 110,000 species in 450 cabinets, on an average of 16 shelves. As I have ascertained that the shelves are in each case about the same width apart, and about equally filled, these figures give roughly three times as many shelves to the Kew Herbarium, and somewhat less than half as many more species.

There can be no doubt, therefore, that the British Museum Herbarium might be materially developed, especially when it is remembered that Mr. Bentham's herbarium, when presented to Kew, contained between 60,000 and 70,000 species, and that this was formed in less than forty years by a single individual. The examination of the unarranged collections in the British Museum would, no doubt, yield a large number of duplicates, and these should be exchanged with foreign herbaria. If this were done—and there is no reason why the appliances of Kew should not be utilised for the purpose—it would be easy, without interfering with the independent action of either establishment, to bring about for the future a mutual interchange of specimens. Nor is there any reason why, when needful, the type specimens of the older botanists should not be lent to Kew from the other Herbarium, considering that both are Government property.

The development of the botanical collections in the rooms open to the public at the British Museum into something more useful, educationally, would probably be achieved by the officers, if they possessed more space. In this case it would be very desirable to transfer to them the collections belonging to vegetable palæontology in the Geological department. At present the nucleus of a collection of fossil plants bequeathed to the Botanical department by Robert Brown is being gradually developed, so that there are now actually two distinct collections, both having the same object, and existing independently of one another, and in charge of different officers, in the same building. W. T. THISELTON DYER

THE RAINFALL AND TEMPERATURE OF NORTH-WESTERN EUROPE

THE Scottish Meteorological Society have just received letters from their observers in Iceland and Faroe, together with the regular observations made by them for the Society to the end of November last, which are of interest in connection with the unprecedentedly wet and changeable season we have had in Scotland and elsewhere.

The rainfall in Iceland this year to the end of October has been 4·84 inches under the average of the ten months, the deficiency occurring chiefly in January, February, July, September, and October. In Faroe the deficiency has, to the end of November, amounted to 11·00 inches, the dry months being February, 4 50 inches under the average; July, 1·09 inch; August, 2·97 inches, and November, 4·17 inches. In Scotland, February was everywhere a wet month, except in the northern and western islands and in Clydesdale; and September, October, and November were very wet months,—all these months being characterised by a small rainfall in the north.

The mean temperature at Stykkisholm, in the north-west of Iceland, was 33°·7 in January, or 6°·8 above the average, being the highest mean temperature recorded in January since 1846, except that of 1862, which was 1°·0 higher; 52°·7 in July, and 51°·6 in August, being respectively 3° 6 and 3°·4 above the average of these months, and the highest that has occurred since July 1847 and August 1846. And as June was 0°·6 and September 1°·0 above the average, the past summer has been one of the finest experienced in Iceland for many years. The temperature in April was 3°·5, in May 1°·4, and in October 1°·0 under the average. On the other hand, the temperature of Faroe closely agreed with that of Scotland during the year, viz., above the average in January, February, March, April, June, July, and November, and under the average during the other months, especially September.

At Melstadt, on the north coast of Iceland, the summer was very fine, but in the beginning of October the weather broke, and on the 13th the temperature fell to 3°·0 or 29°·0 below freezing. At Reykjavik, the summer was also fine, but the autumn was remarkable for north and north-east gales, frequent auroras, low sea temperature, and large amount of ozone. Along with the unusual manifestation of these phenomena, inflammatory diseases were prevalent, especially bronchitis, catarrh, croup, and diphtheria.

The temperature of the sea presented certain very interesting anomalies during the year. In the earlier months it was, equally with the temperature of the air, above the average of former years in Iceland, Faroe, and Scotland. But at Stykkisholm it was 2°·7 in May, and 4°·2 in June below the average, it being at the same time from half a degree to a degree above the average in Faroe and Scotland. On the other hand, the sea was, at Stykkisholm, 2°·8 in August, and 2°·6 in September above the average, whereas at Sandwick, Orkney, it was 1°·2 and 1°·1 below it in the same months. In Faroe the temperature of the sea was above the average every month of the year (except October, when it was 0°·3 below it), amounting during the eleven months to an average excess of 1°·1.

The following are the differences from the averages ot the sea temperatures at Stykkisholm from March to October, 1872:—

March	+ 1°·5	July	+ 1·3
April	— 0·1	August	+ 2·8
May	— 2·7	September	+ 2·6
June	— 4·2	October	+ 0·4

In May the mean temperature of the sea was 36°·7, and in August 53°·1. So great an increase as 17°·6 has not been previously observed in these months.

It is also a noteworthy circumstance that the means of the nine months' barometric pressure, from February to October, at Stykkisholm, have been in every case above the average, amounting to an average monthly excess of 0·118 inch. In Norway also, from February to August, to which the observations have reached us, the means were every month above the average, amounting at Vardoe (lat. 70° 20′) to a mean monthly excess of 0·260 inch; Christiansund, 0·129 inch; Christiania, 0·151 inch; and Maudal, near the Naze, 0·084 inch. On the other hand, barometric pressure was every month from February to October, below the average; at Paris, and in Guernsey, the mean monthly deficiency being respectively 0·074 and 0·090 inch. At Greenwich, the mean deficiency for the last nine months was 0·083 inch; Glasgow, 0·091 inch; Edinburgh, 0·088 inch; Aberdeen, 0·072 inch; Culloden, near Inverness, 0·34 inch; and at Stornoway, the station nearest to Iceland, only 0·006 inch. This high barometer in Iceland and Norway has had an important bearing on the unprecedently wet weather, and the accompanying low barometer we have had south of that region.

ALEXANDER BUCHAN

ON THE SPECTROSCOPE AND ITS APPLICATIONS

IV.

IN what has now been stated we first saw Newton founding spectral analysis, by using a hole in a shutter and a prism; then we discussed Wollaston's substitution of the slit; after that Mr. Simms' introduction of the collimating lens was referred to; and then the growth of the modern spectroscope.

It is time, now, that we came to the applications of the instrument. And in dealing with these applications I shall divide my subject into two perfectly distinct portions. I shall first deal with those which depend upon the different modes in which light is given out or radiated by various bodies under different physical conditions, with, in fact, the *radiation* of light. And, in the second place, I shall deal with the spectroscope's story of the way in which white light giving a continuous spectrum is stopped or absorbed by different transparent bodies—with in fact the *absorption* of light.

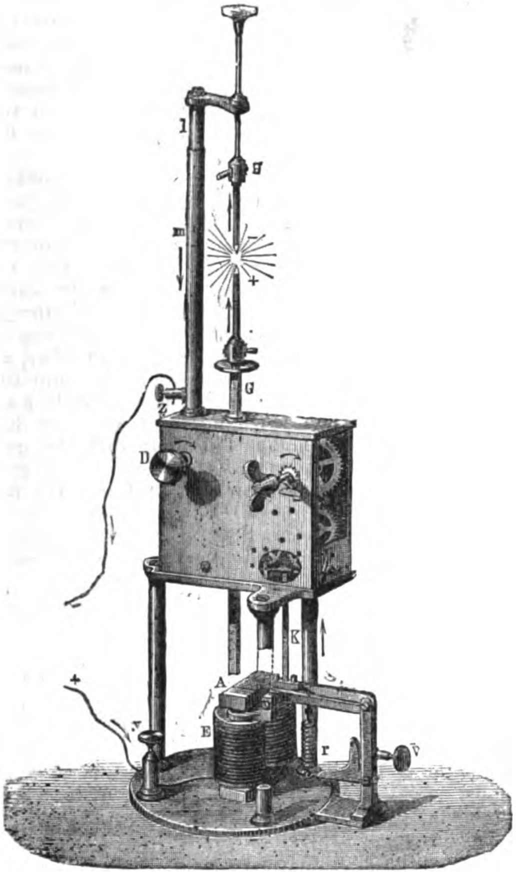

Fig. 19 —Electric Lamp.

The first application of this question of radiation is one of the most general importance. It enables us to differentiate between solid, liquid, and gaseous substances, and between gaseous or vaporous substances in different stages of pressure. If, for instance, we take a platinum wire and heat it to redness, and examine by means of the spectroscope, the light emitted we shall find that only red rays are visible, then if the wire be gradually heated more strongly, the yellow, green, and blue, rays will become visible, until finally when the wire has attained a brilliant white heat, the whole of the colours of the spectrum will be present. If I were to burn a piece of paper, or a match or an ordinary coal gas flame, you all know we should get a white light, but you may possibly not all know that if we raise any solid or liquid to a state of incandescence or glowing heat we should get exactly that same sort of light, which will always give us a continuous spectrum. Before a large audience the best method of showing this fact is to use an apparatus called the electric lamp, and to pass the current of electricity through two carbon points, which are intensely heated by their resistance to the passage of the current. The spectrum obtained from these points, by means of the dispersion of two bisulphide of carbon prisms, is quite continuous from end to end. Now carbon is a solid, and therefore if we take carbon as an example of a solid or liquid substance in a state of vivid incandescence, and we obtain from these carbon points a continuous spectrum, you must accept that as an indication of the truth of what I say, for I have not time to experiment on every solid and every liquid substance. The spectrum is received on the screen, and you see it is continuous, that is to say, there are no breaks, such as those we saw in the figure representing a portion of the solar spectrum on page 167 where the black lines represent the breaks in the solar spectrum which are called the Fraünhofer lines.

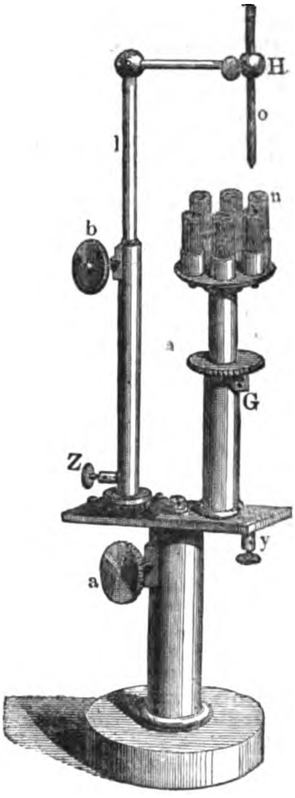

Fig. 20.—Arrangement of the electric lamp used for rapid comparisons.

Let us then consider this fact established, namely, that solid or liquid bodies, when heated to a vivid incandescence, give a continuous sprectrum without bright lines. Under these circumstances the light to the eye, without the spectroscope, will be white, like that of a white hot poker; if the degree of incandescence is not so high, the light may only be red, like that of a red-hot poker. But so far as the spectrum goes—and it will expand towards the violet, as the incandescence increases, as before stated—it will be continuous.

Now, suppose, instead of giving you the spectrum of these solid white-light-giving carbon points or that from an ordinary gas flame, I show you the spectrum of a light source which is coloured. If, for instance, we burn some coloured fire, such as the red fire of our pyrotechnic displays. You must not consider that this is sensational, for Sir John Herschel, very many years ago, was on the eve of discovering the great point of spectrum analysis which I have to bring before you, by merely examining these coloured fires. If we examined such a light by means of the spectroscope you might expect that we should obtain the red end of the continuous spectrum; that on burning green fire we should see the green portion of the spectrum and so on. But this is not so; we find that the background of the spectrum is dark or nearly so, and that we have certain localisations of light or bright lines in different parts of the spectrum. Now, the differences in colour are accompanied by differences in the spectra. We have something very different from the continuous spectrum we had before, and this is, in fact, one of the first practical outcomes of spectrum analysis. It enables you in a moment to determine the difference between a solid or liquid body, which gives you a continuous spectrum, and a vapour or gas, which gives you a spectrum containing bright lines. The reason that different vapours and gases are of different colours is now clear; if we examine the light by means of a spectroscope, we find that the light rays which they emit are located in different parts of the spectrum.

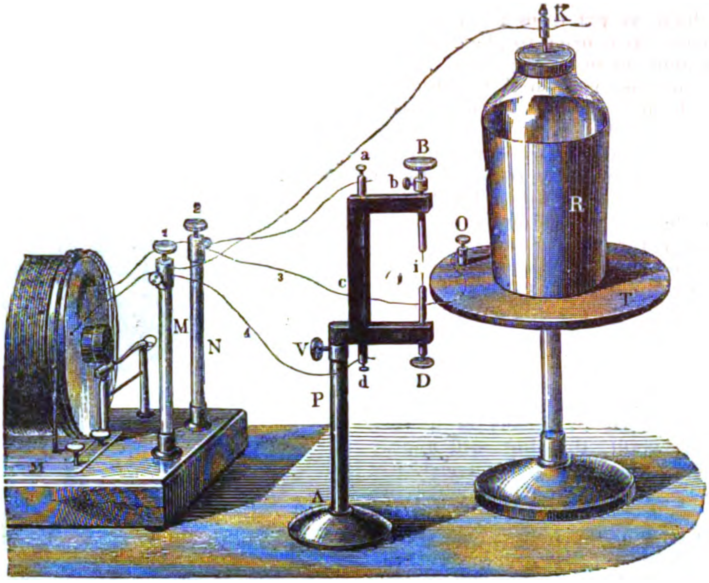

FIG. 21.—Arrangement for determining the spectra of metals by means of the electric spark.

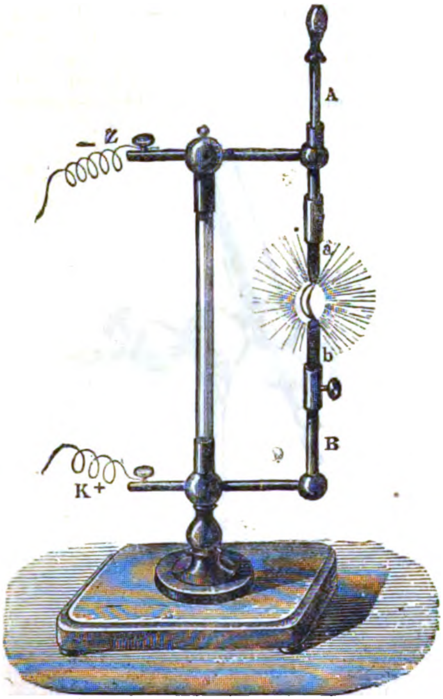

FIG. 22.—The Electric Arc

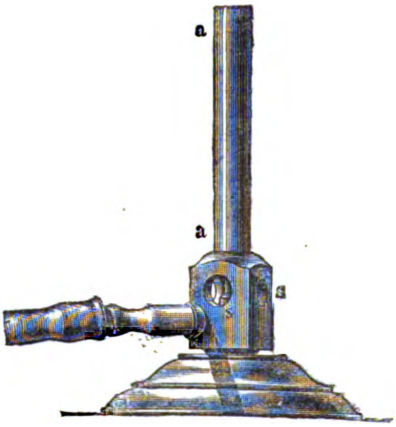

FIG. 23.—Bunsen's burner for flame spectra.

In these instances then, the spectra consist of lines which are located in different parts of the spectrum. Let us burn some sodium in air, and then examine the spectrum of its vapour, or better still, let us place some sodium, or a salt of this metal, such as table salt, in a gas flame which is consuming a mixture of air and gas, in a burner known under the name of a Bunsen's burner, the bluish flame of which is due to the complete com bustion due to the greater supply of air from the holes at the bottom. The flame immediately becomes of an intense yellow colour due to the vapour of sodium. In this we have further evidence of the connection between the colour of the light which we get from a vapour and the spectrum of that vapour. It is usual to place the salt to be examined in a platinum spoon, and insert it in the flame, but the utmost constancy is insured by adopting an arrangement of Mitscherlich's shown in the accompanying drawing, (Fig. 24) in which a platinum wick is kept continually moistened by a solution of the salt, generally the chloride, the spectrum of which is required to be examined. You will imagine, *à priori*, from what I have already said, that as in the case of sodium vapour, the colour of the light is orange, the line of the vapour will appear in the yellow or orange part of the spectrum, and you will not be mistaken. For you will see on examining this flame with a spectroscope, that we obtain a spectrum consisting of a brilliant yellow line upon an almost black background; if, however, the flame is observed by means of a very narrow slit, this line will appear double, that is it really consists of two extremely fine lines which are very close to each other, and if the slit be wide the images overlap one another.

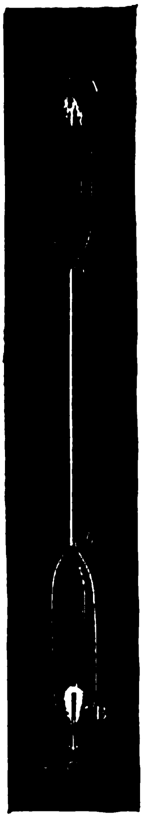
FIG. 24.—Geissler's tube, showing electric discharge.

If we then pass on to another substance, and take some lithium instead of sodium, we obtain a brilliant carmine tinted flame, which on examination by the spectroscope, is found to give a spectrum consisting of one splendid red, and a fainter orange line. Potassium gives a violet coloured flame, and yields in the spectroscope a red line and a violet line. If, again, we take a salt of strontium, which was one of the ingredients in red fire, it colours the flame crimson, and by the eye the flame can scarcely be distinguished from the colour of the lithium flame, but in the spectroscope there is no possibility of doubt, the spectrum of strontium, consists of a group of several lines in the red and orange, and a fine line in the blue end of the spectrum.

If a higher temperature than that of the Bunsen flame is required the blow-pipe flame may be resorted to; in this, the quantity of air and coal-gas is varied at pleasure, and a very high temperature may be obtained.

We might proceed thus to examine all the elementary substances one by one, but to observe the spectra of the metals, it will be found necessary to use a higher temperature still, and for this purpose the electric arc or spark is employed. If a temperature only slightly greater than that of the blow-pipe flame is used, the spark from an induction coil worked by five Grove cells may be taken as shown in Fig. 21, the Leyden jar not being employed; a few metallic lines will then be seen, and a background consisting generally of bands of light here and there.

If a higher temperature still is used, the jar may be thrown into the circuit, upon which the spark will become more intense, according to the power of the coil and size of the jar; or the electric arc may be employed. The spectra thus obtained are much more complex; the spectrum of iron, for instance, when examined at this high temperature, is found to consist of no less than 460 lines, many of which are situated in the green part of the spectrum.

With regard to solid and vaporous bodies, the electric lamp affords a very handy method when properly employed, of examining and exhibiting the spectra of these bodies to large audiences.

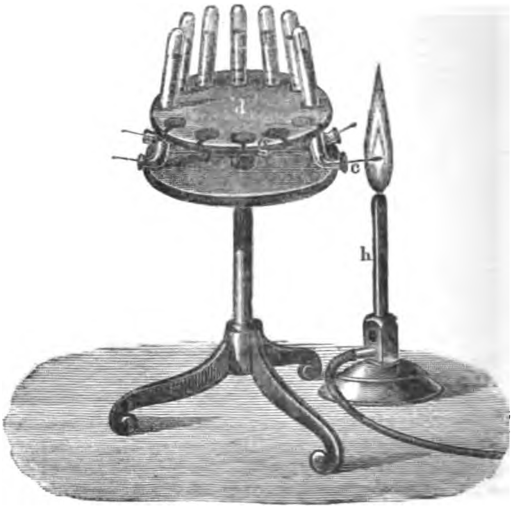

FIG. 25.—Mitscherlich's arrangement for flame spectra.

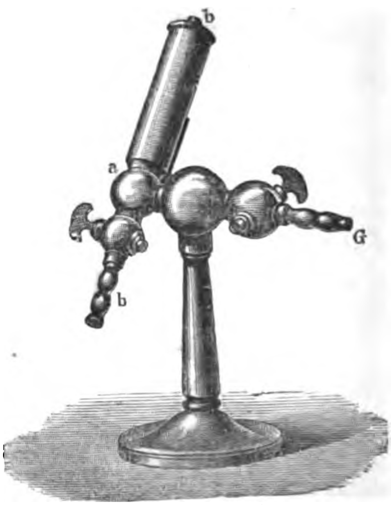

FIG. 26.—Herapath's Blow-pipe.

But there are a great many gases which the spectroscopist also has to study, and to study with the greatest care; and here, I am sorry to say, the electric lamp utterly fails us. The light which we get from a gas by the electric discharge is so feeble that it is quite impossible to throw its spectrum on the screen, so as to be observed by large audiences, for we cannot render strontium incandescent in the way in which we render incandescent sodium and the other substances I have brought before you. But we have other means of examining the spectra. I have here some tubes containing hydrogen and other gases at different pressures, and when we wish to study the spectrum of a gas, we do it in this way: we enclose it in a tube, and send a current through it by means of an induction-coil. If we pass a stream of electric sparks through a tube containing hydrogen at the pressure of one atmosphere, we shall see that the colour of the incandescent gas is a bright carmine red, the spectrum of which can easily be observed by placing the spark tube in front of the slit of one of the spectroscopes before described. This arrangement is one that is in daily use in many of our laboratories, and it must be borne in mind as being the *modus operandi* by which a great deal of the work has been done to which I shall have to allude shortly. If again we take a tube which contains hydrogen that has been extremely rarefied, and pass a series of electric sparks through it, instead of having the brilliant red colour, we shall have a pale greenish spark, quite different from the former. This great difference is due to the difference in the pressures of the hydrogen of the two cases.

The two spectra are equally distinct, the red light shows three splendid lines, one in the red, another in the bluish green, and the third in the violet, together with a considerable amount of continuous spectrum, whilst almost the only spectrum which can be obtained in the second case, is a single green line in the same position as the former green line spoken of. There is also this difference which will be observed, that the green line obtained from the tube at the atmospheric pressure is very broad and indistinct at the edges; and that the line as seen from the almost vacuous tube is very thin, comparatively speaking, and perfectly sharp and well defined. If we were to take another tube, with a pressure somewhere between the two already mentioned, it would be seen that this green line was not so wide and woolly as in the tube at one atmosphere, and yet not so sharp and well defined as in the almost vacuous tube. Thus it will be seen that this widening out of the line is due to the difference of pressure.

J. NORMAN LOCKYER

(*To be continued.*)

NOTES

OUR readers will be sorry, though not surprised, to hear that the venerable Professor Sedgwick died at Trinity College, Cambridge, on the morning of the 27th instant, aged 87 years. He was fifth wrangler in Trinity in 1808, and was elected to a fellowship in 1810. His contributions to science were very numerous, and are mainly to be found in the Transactions of various learned societies.

THE Vice-Chancellor of Cambridge University has given notice that the election of a Woodwardian Professor of Geology, in the place of Dr. Sedgwick, will be held in the Senate House on Thursday, February 20, at 1 P.M. The Vice-Chancellor and Proctors will receive the votes from 1 to 2.30, when the election will be declared. The stipend attached to the professorship is 500*l*. per annum.

WE are very glad indeed to hear that renewed and better organised efforts are likely to be made to induce Government to undertake the expense of an Arctic expedition. We have good reason to believe that Sir Henry Rawlinson will address a letter to the President of the Royal Society urging the importance of that body taking a lead in the advocacy of such an expedition. This is as it should be, and we have no doubt if the matter is gone about in a thoroughly well considered manner, a second rebuff will not be experienced. Meanwhile we are glad to learn from an obliging correspondent that Mr. Leigh Smith will proceed on his third voyage of Arctic discovery in the spring. He has a fine strong steamer, the *Diana*, admirably adapted for the purpose; and will undoubtedly achieve all that can be done in the way of discovery in the Spitzbergen seas, during the season of 1873. For Mr. Smith is a good observer and explorer, and is now becoming a veteran Arctic voyager. In 1871 he made the most remarkable voyage in that direction since 1707, discovering a large extent of coast line both on the north and south sides of North East Land. He also attained the highest latitude that has been reached in a ship, except by Scoresby and the Swedes. In 1872 he went out again, and though the unfavourable state of the ice prevented him from doing much, he succeeded in taking a very important series of observations of sea-temperatures at various depths. In 1873 he will again, with better means and in a steamer instead of a sailing vessel, make an attempt to explore the unknown lands east of Spitzbergen, and to attain the highest latitude that skill and perseverance will enable him to reach.

THE Senior Wrangler at Cambridge this year is Mr. Thomas Olver Harding, eldest son of the Rev. Thomas Harding, Wesleyan minister of Whitehaven. Mr. Harding, in January, 1866, gained the first exhibition at the matriculation examination of the London University, and the Gilchrist Scholarship at University Hall. In 1867 he gained the Andrews Scholarship in mathematics at University College. In 1868 he proceeded to the degree of B.A., in the University of London; and in 1869 and 1871 he passed the first and second examinations for the degree of B.Sc., gaining the exhibition in mathematics at each. Last year he was elected fellow of University College. In 1869 he entered Trinity as senior minor scholar in mathematics, and was elected foundation scholar in 1871. Mr. Harding has just completed his twenty-third year. His private tutor was Mr. Routh; his college tutor the Rev. E. W. Blore. The Second Wrangler, Mr. Edward John Nanson, was educated at the Grammar Schools of Penrith and Ripon. In 1869 he obtained a Minor Scholarship at Trinity College. In July 1869, he commenced reading with Mr. Routh, of St. Peter's College. In 1870 he obtained a Foundation Scholarship. He was Prizeman, and placed in the first class at each of the annual College Examinations. His college tutor was Mr. Blore.

AN alteration has been made in Prof. Tyndall's arrangements. We are now enabled to state that he will leave America on the 5th of next month in the *Cuba*.

WE are glad to see from the account of the annual meeting of the Anthropological Institute officially forwarded to us, that Prof. Busk has been elected President, and along with him the following strong Council:—Vice-Presidents—John Beddoe, M.D.; J. Barnard Davis, M.D., F.R.S.; John Evans, F.R.S.; Col. A. Lane Fox, F.S.A.; Prof. Huxley, F.R.S.; Sir John Lubbock, Bt., F.R.S. Director—E. W. Brabrook, F.S.A. Treasurer—J. W. Flower, F.G.S. Council—H. G. Bohn, F.R.G.S.; Capt. R. F. Burton; A. Campbell, M.D.; Hyde Clark; W. Boyd Dawkins, F.R.S.; Prof. P. M. Duncan, F.R.S.; Robert Dunn, F.R.C.S.; David Forbes, F.R.S.; A. W. Franks; Francis Galton, F.R.S.; C. R. Markham, C.B.; Capt. Sher. Osborn, C.B., R.N.; Capt. Bedford Pim, R.N.; F. G. H. Price, F.G.S.; J. E. Price; F. W. Rudler, F.G.S.; C. R. Des Ruffières, F.R.S.L.; W. Spottiswoode, V.P.R.S.; E. Burnet Tylor, F.R.S.; A. R. Wallace, F.L.S.

A WORK of considerable importance, a geological map of Australia and Tasmania, has been recently commenced by Mr. R. Brough Smyth, secretary to the Mining department of the Australian Government, which, when finished, will be of value not only to the colony, but to the whole scientific world. As the Minister of Mines has cordially approved of the work, it is intended to communicate with the Governments of the various colonies, forwarding a draft of the map after it has been partially completed from the sources at hand, and a scale showing the colours of the various rock formations, with a request that they will as far as possible fill in the blanks from the records of the departments in the respective colonies. By this means it is anticipated that much reliable information will be obtained, as no doubt the surveyors-general of the colonies have in their possession many reports relative to the rock formations of their colonies. The map has been compiled from various sources, some of the maps and reports from which it has been taken having been completed as far back as 1834; but to show the accuracy with which the various surveys have been made, it may be mentioned that in some cases where the geological formation of a district has been compiled from two surveys, made perhaps at the interval of many years, and by different individuals, they have been found to join one another without the slightest mistake. Northern Australia is at present considered almost a *terra incognita* with regard to its geological character, but still a good portion of this part of the continent has been completed from the records of old explorers. It is intended by the compiler that in the first map only the boundaries of the several rock formations will be shown, as there are many large areas whose geological position has not yet been ascertained, and therefore no attempt will be made to classify them unless such classification is based on thorough geological information. The map will not be complete at first, but even in its present condition it will be of considerable value, and as the information it contains will be added to year by year, in the end it will become invaluable to the geological students of Australia.

THE Atlantic telegraph cable authorities have just done a very handsome thing. Astronomers belonging to different countries have, for some time past, felt the great inconvenience caused by the delay in transmitting notes of observations of new planets, comets, &c., by post, and therefore, especially in America, the Atlantic Cable naturally suggested itself as a means of exchanging discoveries. But the great expense of despatches by it, and the poverty of astronomers, have prevented their making use of this means of communication to any great extent. For some time past, the scientific editor of *Harper's Weekly* informs us, Prof. Henry, of the Smithsonian Institution, has been in correspondence with the authorities of the cable for the purpose of inducing them to transmit such communications free, and at last has had the pleasure of receiving from Mr. Cyrus W. Field the announcement that this boon has been granted. The precise details of the arrangement to be made are not yet fully established, but it is probable that, in case of important discoveries in America, the fact will be communicated by telegraph to the Smithsonian Institution, which will at once forward it to the observatories in Paris, London, Berlin, and Vienna, which, in turn, will supply the information to their associates. These same institutions will be the recipients, by telegraph, of the first announcements in Europe, to be transmitted to the Smithsonian Institution as before, and the information sent from Washington, either by the medium of the Associated Press, or by direct telegraphic despatch. The directors of the Atlantic Telegraph deserve great credit for their enlightened liberality, and for thus aiding in the scientific work of the day; and it is to be hoped that the inland American telegraph lines, as well as those in Europe, will not be behind in their co-operation, so as to make it an absolutely free interchange from one country to the other. It is probable that the information in regard to the discovery of comets in America will be sent more directly to the Vienna Academy of Sciences, as that body has a standing offer of reward for all such announcements, made under certain specific conditions.

M. LE BARON PIERRE CHARLES FRANCOIS DUPIN, who, so long ago as 1818, was elected to the French Academy for his geometrical writings, died on January 18, aged 89 years.

PROF. HUXLEY, the new Lord Rector of Aberdeen University, has given his friends there to understand that it will be impossible for him to deliver an inaugural address during the currency of the present session. He hopes to be able to do this at the beginning of next session.

THE following are the scientific arrangements at Oxford for this term:—The Rev. Bartholomew Price, M.A., will lecture on the "Dynamics of Rigid Systems," beginning on Thursday, Feb. 6. The Rev. C. Pritchard, M.A., will lecture on "The Ninth and Eleventh Sections of the Principia and the Lunar and Planetary Theories," beginning on Tuesday, Feb. 4. R. B. Clifton, M.A., will lecture on "Optical Instruments and Physical Optics," beginning on Saturday, Feb. 1. The Physical Laboratory of the University will be open daily for instruction in Practical Physics, from 10 to 4 o'clock, on and after Thursday, Jan. 30. G. Rolleston, D.M., will lecture on the "Nervous System," beginning on Friday, Jan. 31. The workrooms in the Anatomical Department are open daily, from 10 A.M. to 5 P.M. for practical instruction, under the superintendence of Mr. Charles Robertson, the Demonstrator of Anatomy, and Mr. S. J. Sharkey, of Jesus College. A special class will be formed for instruction in Practical Microscopy. Mr. E. Ray Lankester, M.A., of Exeter Coll., will lecture "On the General Classification of the Animal Kingdom," on Saturdays, at 1 o'clock, beginning Feb. 1. J. O. Westward, M.A., will deliver four lectures on Entomology—1, Structure; 2, Transformations; 3, Economy; 4, Classification of Articulata, beginning Feb. 14. J. Phillips, M.A., being engaged in arranging a part of the Museum collections, does not purpose to lecture in the present term; but he will be happy to meet members of the University, and to assist students of geology, *sine ulla solennitate*, on Mondays and Wednesdays, in the Museum, at 12 o'clock. Marmaduke Lawson, M.A., will continue his course of lectures this term.

THE following Lectures in Natural Sciences will be given at Cambridge during Lent Term. On Electricity and Magnetism, by Dr. Trotter, Mondays, Wednesdays, Fridays, at 11, commencing Friday, Jan 31. On Electricity and Magnetism (for the First Part of the Natural Sciences Tripos and the Special Examination for the Ordinary Degrees), by Mr. Trotter, Tuesdays, Thursdays, Saturdays, at 11, commencing Thursday, Jan. 30. On Chemistry, by Mr. Main, St. John's College, Tuesdays, Thursdays, Saturdays, at 12, commencing Thursday, Jan. 30. Instruction in Practical Chemistry will also be given. On Palæontology (the Annuloida, &c.), by Mr. Bonney, St. John's College, Tuesdays and Thursdays, at 9, commencing Thursday, Jan. 30. On Geology, (for the Natural Sciences Tripos, Physical Geology), by Mr. Bonney, Mondays, Wednesdays, and Fridays at 10, commencing Wednesday, Jan. 29. Elementary Geology (for the First Part of the Tripos and the Special Examination), Tuesdays and Thursdays at 11, commencing Tuesday, Feb. 4. On Botany (for the Natural Sciences Tripos), by Mr. Hicks, Sidney College, Tuesdays, Thursdays, Saturdays, at 11, in Lecture Room No. 1, beginning on Thursday, Jan. 30. On the Physiology of the Senses, by Dr. M. Foster, Mondays and Wednesdays at 1. A Course of Practical Physiology on Thursdays, at 11 A.M., commencing Thursday, Feb. 6. An Advanced Course of Practical Histology on Tuesdays, at 11 A.M., commencing Tuesday, Feb. 4.

A SLIGHT eruption of Vesuvius occurred last Saturday. Red-hot stones were thrown up in the midst of flames to a considerable height throughout the whole of yesterday, and at Castellamare the windows were shaken. On Sunday morning an unusual amount of smoke was issuing from the mountain.

THE Meteorological Society of Mauritius have resolved to prepare as complete a list as possible of the hurricanes which have been felt at Mauritius and at Bourbon in former times, and of the years that have been remarkable for droughts or rainfall. Their main purpose in doing so is to test the hypothesis that the frequency of storms and the amount of rainfall have periodicities. Meantime preliminary lists of hurricanes at the two places have been prepared, in the case of Bourbon from 1733 to 1754, and in the case of Mauritius from 1695 to 1847. In the former list there are only two years, 1741 and 1749, in which no mention is made of hurricanes, while the latter is apparently much more incomplete, having many gaps. While some of these gaps may be owing to the absence of hurricanes, still, no doubt, hurricanes have occurred which are not included in the list. But it is remarkable that many of the gaps occur about the time of minimum frequency of sun spots. It is to be hoped that the Society will be able to compile a pretty complete and trustworthy list, as such a list would go far to solve questions of high importance. It is to be hoped that with an efficient observatory, which Mauritius is likely soon to possess, and uninterrupted observation, complete data for future meteorologists may be gradually collected.

THE following note from the *Colonial Farmer* (Fredericton, New Brunswick), concerning the recent shower, has been forwarded us:—A brilliant meteoric display was observed in the heavens early on Wednesday evening, Nov. 27th, and the clearness of the night gave every facility for witnessing this attractive exhibition. For at least two hours the falling meteors were visible in hundreds, and seemed to come from the Milky Way, with a course from the zenith to the south and south-west. Above 190 were counted in about twenty minutes. The shower commenced at dusk, and continued for two hours with increasing brilliancy, after which it gradually faded away.

SOME months ago we announced that the glass of the great telescope of the Alleghany Observatory, one of the largest of the kind in America, and valued at about 4,000 dols., was stolen from the building, and all efforts to detect the robber and regain the plundered article were unavailing. We now learn from the *College Courant* that the lens has been recovered, having been stolen by two men, but for what purpose is not said. It was found to have received serious damage in the form of several scratches, which may require the regrinding of the glass at a cost of 30 or 40 per cent. of the original cost.

WE learn from the *Athenæum* that Mr. Edward Thomas has been elected corresponding member of the French Academy, for his contributions to Oriental Numismatic Archæology.

WE learn from the *British Medical Journal*, that Dr. C. J. B. Williams has been nominated by the Council of the Royal Medical and Chirurgical Society for the Presidency.

MR. E. B. NICHOLSON, librarian of the Oxford Union Society, has been appointed to the Librarianship of the London Institution, in room of the late Mr. J. C. Brough.

THE Fifth Annual Report of the Eastbourne Natural History Society shows that it continues prosperous, and has been making valuable additions to our knowledge of the Natural History of the district in all its departments.

THE lioness, which has so successfully reared the cubs born in the Zoological Gardens, July 8, 1872, died on the 21st inst.

WE have received an advance sheet of the next number of Petermann's *Mittheilungen* containing the second article on Dr. Livingstone's Exploration of the Upper Congo, appended to which is a splendidly constructed map of the section of Africa included between 2° and 12½° S. lat. and 22°—40° E. long., in which not only the most recent discoveries are filled in, but the routes of all travellers are given from Lacerda in 1798 down to Livingstone and Stanley in 1871-2. Moreover by seven shades of colour the heights of the various regions are indicated from 1000 up to 18,710 feet.

THE whole of No. 34 of the supplement to Petermann's *Mittheilungen* is occupied with the journal kept by Jerhard Rohlfs, who in 1865-6-7, journeyed through North Africa, from Lake Tsad to the Gulf of Guinea. Two magnificent maps accompany the narrative, the one representing the region to the south of Lake Tsad, and showing the routes of Rohlfs and of all previous travellers through that region; the other represents the country from Borneo to Lagos, and contains the routes of travellers from Clapperton and Landor down to Rohlfs.

LIEUTENANT GRANDY, leader of the Livingstone Congo Expedition, has written to Sir Henry Rawlinson reporting his arrival at Sierra Leone on December 14, where he got together his exploring party, consisting of his brother, Mr. M. B. Grandy, two Congo men to act as interpreters, 19 Kroomen, and a steady native from the police, Daniel E. Gabbidon. The party left for the South Coast on the 27th, in good health, after an inspection and a few cheering words at Government-house. The local Government presented Lieutenant Grandy with a travelling tent, water-proof blankets, and other useful articles.

WE are glad to see that the botanical members of the Perthshire Society of Natural Science are preparing "a Flora of Perthshire," one of the richest counties, botanically, in the kingdom. Botanists who can assist with information are requested to communicate at once with Dr. Buchanan White, Dunkeld, than whom no more competent editor could be found.

A MEETING was held the other evening which pledged itself to use every effort to establish a South London Museum on the model of that recently opened at Bethnal Green.

THE first of a series of lectures was given on Tuesday evening the 21st inst., on the "Physical Geography of the Sea," in the Town Hall, Shoreditch, by Dr. Carpenter. The lecture was listened to by an audience of 2,000 persons, chiefly of the working classes, men and women, with marked attention, for nearly two hours.

A COLLECTION of Saxon antiquities, of rare value, has been presented to the library and museum of Trinity College, Cambridge, by Mr. White, sub-librarian of the society. These were obtained from the site of an Anglo-Saxon cemetery, situate at a place known (and described on maps 200 years old) as "Edixhill hole," near Orwell, Cambridgeshire. Mr. White's donation includes various implements in iron and spear heads, shield bosses, and handles, &c., and some articles used in hunting and for domestic use. Among the collection are three jaw bones, one of immense size, all having the teeth perfectly sound. The collection has been deposited in the library.

THE *Medical Record* for January 15, in a note entitled "Science the Peace-maker," has the following:—"Immediately after the war, the French Societies occupied themselves in striking off the roll the names of all German Associates, and French *savans* withdrew theirs from the German societies of which they were honorary members. We are glad to note, as indicating a return to a more sound and philosophic mind, that at a recent meeting of the Berlin Chemical Society M. Cahours, an eminent Frenchman, applied for, and was accorded, admission to the honorary membership."

THE principal article in the *Revue Scientifique* for January 25 is a long one by M. Léon Dumont on the theory of evolution in Germany, with special reference to the doctrines of Haeckel.

A WELL-KNOWN British explorer, in the person of Commander Alexander John Smith, has recently died at Sandhurst, Victoria. This gentleman was lieutenant on board the *Erebus*, under Captain Sir James Clark Ross, in the expedition to investigate the magnetism of the Antarctic region, and was subsequently one of the officers in charge of the magnetic observatory at Hobart Town.

THE SCIENTIFIC ORDERS OF THE "CHALLENGER"*

II.

II. *Chemical Observations*

SAMPLES of sea-water should be collected for chemical analysis at the surface and at various depths, and in various conditions. Each sample should be placed in a Winchester quart glass-stoppered bottle, the stopper being tied down with tape and sealed in such a manner that the contents cannot be tampered with.

2. Portions of the same samples should be, immediately after their collection, boiled *in vacuo*, the gases collected, their volume determined as accurately as may be, and a portion, not less than one cubic inch, hermetically sealed in a glass tube, to be sent home at any time for complete analysis.

3. Frequent samples of sea-water taken at the surface, and others taken beneath as opportunity offers, should have determinations of chlorine made upon them at once or as soon as convenient.

This operation could easily be carried on in any but very heavy weather. On the other hand, it is not thought that any trustworthy analyses of gases could be made on board ship, unless in harbour or in the calmest weather.

4. Such samples of the sea-bottom as are brought up should be carefully dried and preserved for examination and analysis.

5. The gas contained in the swimming-bladders of fishes caught near the surface and at different depths should be preserved for analysis. In each case the species, sex, and size, and especially the depth at which the fish was caught, should be stated.

III. *Botanical Observations*

The duties of a botanist in travelling are twofold, and in the case of the voyage of circumnavigation about to be undertaken by H.M.S. *Challenger* they are of equal importance.

Of these, the one refers to forming complete collections of the plants of all interesting localities, and especially of the individual islands of oceanic groups.

The other, to making observations upon life, history, and structure in the case of plants where special knowledge is concerned.

In the first of these the botanist must necessarily be largely helped by the assistance to be obtained on board ship from the officers and crew, working under his guidance and close supervision. When time and opportunity are wanting for making complete collections, preference should be given to the phanerogamous vegetation.

In the second he will have to depend upon his own resources, and will therefore require that the mere process of collection does not make too great demands upon his time, although in itself exceedingly important, and by no means to be neglected.

The general directions for travellers, printed in the Admiralty Manual of Scientific Inquiry, will of course be kept in view.

Especial stress must, however, be laid upon the necessity of obtaining information about the vegetation of oceanic islands. These are, in many cases, the last positions held by floras of great antiquity; and, as in the case of St. Helena, they are liable to speedily become exterminated, and therefore to pass into irremediable oblivion when the islands become occupied.

Of many that lie not far from the usual tracks of ships, absolutely nothing is known, whilst of the flora of a vast majority we possess most imperfect materials. The following are especially worth exploring; and to the list is added an indication of the least explored coast lines of the great continents. As far as possible complete dried collections should be made, not only of each group, but of each islet of the group; for it is usually the case that the floras of contiguous oceanic islets are wonderfully different. Of those in italics the vegetation is absolutely unknown, or all but so.

1. ATLANTIC OCEAN. Cape de Verd, Tristan d'Acunha *Fernando Noronha*, *Trinidad* and *Martin Vaz* (off the Brazil coast), *Diego Ramirez*, S. Georgia. The African coast between Morocco and Senegal, the Gaboon, and Damara Land offer the most novel fields. On the American coast, Cayenne, Bahia to Cape Frio, Patagonia.

2. WEST INDIES. The Bahamas and St. Domingo and the Antilles have been very imperfectly explored except Dominica, Trinidad, and Martinique. On the mainland, Honduras, Nicaragua, and the coast region of Mexico, the Mosquito shores, and Guatemala offer rich fields for botanical research.

3. INDIAN OCEAN. The Seychelles, *Ammirantes*, Madagascar, Bourbon, *Socotra*, St. Paul's, and Amsterdam Islands, *Prince Edward's*, the *Crozets* and *Marion* groups. Of the E. African coast to the north of Natal no part is well explored, and the greater part is utterly unknown botanically.

4. PACIFIC OCEAN. (1.) N. TEMPERATE. Collections are wanted from N. Japan and the Kuriles and Aleutian Islands. (2.) TROPICAL. Considerable collections have been made only in the Sandwich Islands, Figi Islands, Tahiti, and New Caledonia; from all of which more are much wanted. The Marquesas, New Hebrides, *Marshall's*, Solomon's and *Caroline's*, together with all the smaller groups, are still less known. Of the American continent, the Californian peninsula, Mexico, and the whole coast from Lima to Valparaiso, are but imperfectly known. Of the small islands off the coast, Juan Fernandez and the Galapagos alone have been partially botanised. 3. S. TEMPERATE. Juan Fernandez, *Masafuera*, St. Felix, and Ambroise, *Pitcairn*, *Bounty*, *Antipodes*, *Emerald*, *Macquarie* Islands.

5. INDIAN ARCHIPELAGO. Java alone is explored, and the Philippines very partially; collections are especially wanted from all the islands east of Java to the Louisiade and Solomon Archipelagos, especially Lombok and New Guinea. Siam, Cochin China, and the whole Chinese sea-board want exploration.

6. AUSTRALIA. All the tropical coasts are very partially explored.

Photographs or careful drawings of tropical vegetation often convey interesting information, and should contain some reference to a scale of dimensions.

An inquiry of much importance, for which the present expedition affords a favourable opportunity, is that into the vitality of seeds exposed to the action of sea-water.

Observations should especially be made on the fruits and seeds of those plants which have become widely distributed throughout the tropical regions of the world, apparently without the intervention of man; but further observations on other plants of different natural orders may be of great value with reference to questions of geographical distribution.

The following instructions have been drawn up for the botanical collectors as to objects of special attention at particular places:—

Porto Rico.—In collecting, distinguish the plants of the Savannahs from those of the mountains, which, if possible, should be ascended. The palms and tree-ferns are quite unknown; marine algæ also are wanted.

Cape de Verdes.—Make for the highest peaks, where the vegetation is peculiar, and analogous to that of Madeira and the Canaries.

Fernando de Noronha.—Land if possible. Very remarkable plants are said to occur, different from those of Brazil.

Trinidad.—A complete collection is required. A tree-fern exists, but the species is unknown.

Prince Edward's Island and Crozets.—Two spots more interesting for the exploration of their vegetation do not exist upon the face of the globe. Every effort should be made to make a complete collection.

Kerguelen's Land.—A thorough exploration should be made, and the cryptogamic plants and algæ diligently collected. The Antarctic Expedition was only there in midwinter; flowering specimens of *Pringlea* are wanted.

Auckland and Campbell Islands.—The floras should be wel explored.

South Pacific and Indian Oceans.—Attend to general instructions, more especially as regards palms and large monocotyledons generally. Marine algæ are said to be scarce, and should be looked for all the more diligently. In the North Pacific, south temperate algæ are said to prevail.

Aleutian Islands.—Collections are particularly wanted.

Every effort should be made to land on islands *between lat.* 30° N. *and* 30° S. along the marked track (between Vancouver Island and Valparaiso), so as to connect the vegetation of the American continent with the traces of it that exist in the Sandwich Islands.

Straits of Magellan.—Cryptogams are abundant, but very partially explored.

The following additional notes have been drawn up for the more especial guidance of the botanists of the circumnavigation :—

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* Continued from p. 193.

Phanerogams.—1. Fleshy parasitic plants (*Balanophora*, *Rafflesia*, &c.) are little suitable for dissection and examination unless preserved in spirit, and the same remark applies to fleshy flowers and inflorescences generally. Dried specimens, however, are not without their value, and should always be obtained as well.

2. The stems of scandent and climbing plants are often very anomalous in their structure. Short portions of such stems should be collected when the cross section is in any way remarkable, with the foliage, flowers, and fruit when possible. A few leaves and flowers should also be tied up between two pieces of card, and attached at once to the specimens of the stem, so as to ensure future identification.

3. Attention should be given to the esculent and medicinal substances used in various places. Specimens should be obtained, and whenever possible, they should be accompanied by complete specimens of the plants from which such substances are obtained.

4. The common weeds and ruderal plants growing about ports or landing-places should not be overlooked, and, as far as practicable, trustworthy information should be recorded as to the date and circumstances of the introduction of foreign species.

5. The distribution of marine Phanerogamic plants (*Zostera*, *Cymodocea*, &c.) should also be noted, and specimens preserved with their latitude and longitude. Their buds and parts of fructification should be put into spirit.

6. The flowers of *Loranthaceæ* and *Santalaceæ* should be preserved in spirit, and also dried to exhibit general habit.

7. The inflorescence of Aroids should be dissected when fresh, or put into spirit. Note the placentation and position of the ovules.

8. Devote especial attention to the study of Screw-Pines and Palms when opportunity arises, even if necessary to the neglect of other things. The general habit of the plants should be sketched; the male and female inflorescence should be preserved, and also the fruit; the foliage should be dried and folded, and packed in boxes. Many fleshy vegetable objects may be "killed" by a longer or shorter immersion in spirit. They then dry up without decaying, and form useful specimens.

9. With respect to Palms, further note the height, position of the spadix, and preponderance of the sexes in both monœcious and diœcious species, also form and dimensions of leaves.

10. Surface-drifting should be examined, and any seeds or fragments of land-plants carefully noted when determinable, with directions of currents and latitude and longitude.

11. Facts are also required as to the part played by icebergs in plant-distribution. If any opportunity occurs for their examination, it would be desirable to preserve and note any vegetable material which might be found upon their surface; also to examine any rock-fragments for lichens.

12. *Ferns.*—Ferns should always, when possible, be obtained with fructification. In the case of tree-ferns, our knowledge of which, from the imperfection of material for description, is very defective, a portion of the stem sufficient to illustrate its structure should be obtained, with notes of its height; a fragment of a frond (between pieces of card) and the base of a stipes should be tied to the specimen of the stem; also a note as to whether the adventitious roots were living or dead.

The number of fronds should be counted, their dimensions taken, and the basal scales carefully preserved.

Note if tree-ferns are ever attacked by insects or fungi, and whether they form the food of any class of animals.

13. *Mosses, &c.*—Many mosses are aquatic. In the case of diœcious species of mosses, plants of both sexes should be, when possible, secured.

14. Aquatic species of *Ricciaceæ* should be looked for. Minute *Jungermanniaceæ* are found on the foliage of other plants.

15. *Podostemaceæ* are found in rocky running streams in hot countries. They have a remarkable superficial resemblance to Hepaticæ. Except at the flowering season they are altogether submerged. Specimens should be preserved in spirit as well as dried.

16. *Fungi.*—Take notes of all fleshy fungi, especially as regards colour; the spores should be allowed to fall on paper, and the colour of these noted also. The fleshy species may sometimes be advantageously immersed in spirit before preparing for the herbarium.

17. Examine the fungi which grow on ants' nests, taking care to get perfect as well as imperfect states, and to secure, if possible, specimens which have not burst their volva.

18. Look out for luminous species, and ascertain whether they are luminous in themselves, or whether the luminosity depends on decomposition.

19. Secure specimens of all esculent or medicinal fungi which are sold in bazaars, noting, if possible, the vernacular name.

20. Note any species of fleshy fungi which arise like the *Pietra Fungaja* from a mass of earth impregnated with mycelium, or from a globose resting-mass.

21. Attend especially to any fungi which attack crops, whether cereal or otherwise; and particularly gather specimens of vine-mildew and potato-mildew, should they be met with. Even common wheat-mildew, smut, &c., should be preserved.

22. In every case note date of collection, soil, and other circumstances relative to particular specimens.

23. Look after those fungi which attack the larvæ of insects.

24. In the case of the *Myxogastres*, sketches should be made on the spot of their general form, with details of microscopic appearance. It would be worth while attempting to preserve specimens for future microscopic examination by means of osmic acid.

25. *Algæ.*—Marine algæ may be found between tide-marks attached to rocks and stones, or rooting in sand, &c.; those in deeper water are got by dredging, and many are cast up after storms; small kinds grow on the larger, and some being like fleshy crusts on stones, shells, &c., must be pared off by means of a knife.

The more delicate kinds, after gentle washing, may be floated in a vessel of fresh water, upon thick and smooth writing or drawing paper; then gently lift out paper and plant together, allow some time to drip; then place on the sea-weed clean linen or cotton cloth, and on it a sheet of absorbent paper, and submit to moderate pressure—many adhere to paper but not to cloth; then change the cloth and absorbent paper till the specimens are dry. Large coarser kinds may be dried in the same way as land-plants; or are to be spread out in the *shade*, taking care to prevent contact of rain or fresh water of any kind; when sufficiently dry, tie them loosely in any kind of wrapping paper; those preserved in this rough way may be expanded and floated out in water at any time afterwards. A few specimens of each of the more delicate algæ ought to be dried on mica or glass. A note of date and locality ought to be attached to every species.

Delicate slimy algæ are best prepared by floating out on smooth-surfaced paper (known as "sketching paper"), then allowed to drip and dry by simple exposure to currents of air, without pressure.

26. Very little information exists regarding the range of depth of marine plants. It will be very desirable that observations should be made upon this subject, as opportunity from time to time presents itself.

Professor Dickie remarks, and the caution should be borne in mind:—"When the dredge ceases to scrape the bottom, it becomes in its progress to the surface much the same as a towing-net, capturing bodies which are being carried along by currents, and therefore great caution is necessary in reference to any marine plants found in it. Sea-weeds are among the most common of all bodies carried by currents near the surface or at various depths below, and from their nature are very likely to be entangled and brought up."

27. Carefully note and preserve algæ brought up in dredge in moderate depths, under 100 fathoms, or deeper. Preserve specimens *attached* to shells, corals, &c. which would indicate their being actually *in situ*, and not caught by dredge as it comes up.

28. Examine mud brought up by dredge from different depths for living Diatoms; examine also for the same purpose the stomachs of *Salpæ* and other marine animals.

29. Note algæ on ships, &c. with the submerged parts in a foul condition; also preserve scrapings of coloured crusts or slimy matter, green, brown, &c.

30. Observe algæ *floating*, collect specimens, noting latitude and longitude, currents, &c.

31. Examine loose floating objects, drift-wood, &c. for algæ. If no prominent species presents itself, preserve scrapings of any coloured crusts. Note as above.

32. It might be useful to have a few moderate-sized pieces of wood, oak, &c. quite clean at first, attached to some part of the vessel under water to be examined, say, monthly. The larger

or shorter prominent algæ should be kept and noted, and crusts on such examined and preserved, with notes of the vessel's course.

33. Various instances have been mentioned by travellers of the coloration of the sea by minute algæ as in the Straits of Malacca by Harvey; any case of this kind would be worth especial attention.

34. The calcareous algæ (*Melobesia*, &c.) are comparatively little known, and are apt to be overlooked.

35. Fresh-water algæ should be collected as occasion presents. Prof. Dickie states that they may be either dried like the marine kinds, or preserved in a fluid composed of 3 parts alcohol, 2 parts water, 1 part glycerine, well mixed.

36. Cases are recorded of the presence of algæ in hot springs. If such are met with, the temperature should be noted and specimens preserved.

IV. *Zoological Observations*

As the scientific director of the expedition is an accomplished zoologist, and has already had much experience in marine exploration, it will suffice to offer a few suggestions under this head.

The quadrant-like zone of the Pacific, which separates the northern and eastern boundaries of the Polynesian Archipelago (using "Polynesia" in its broadest sense as inclusive of "Micronesia") from the coasts of N. Asia and America, is as little explored from the point of view of the physical geographer as from that of the biologist. It would be a matter of great importance to examine the depth, and the nature of the deep-sea fauna, of this zone by taking a line of soundings and dredgings in its northern half (say between Japan and Vancouver) and in its eastern half (say between Vancouver and Valparaiso). If practicable, it would further be very desirable to explore the littoral fauna of Waihou, Easter Island, or Sala y Gomez, with the view of comparing it critically with that of the west coast of South America.

If H.M.S. *Challenger* passes through Torres Straits, it will be very desirable to examine the littoral fauna of the Papuan shore of the straits in order to compare it with that of the Australian shore. The late Professor Jukes, in his "Voyage of the *Fly*" many years ago, directed attention to this point and to its theoretical bearings.

The hydrographic examination of "Wallace's line" in the Malay archipelago, and of the littoral faunas on the opposite sides of that line, is of great importance, considering the significance of that line as a boundary between two distributional provinces. An additional interest has been given to the exploration of this region by Capt. Chimmo's recently obtained sounding of 2,800 fathoms in the Celebes Sea, the mud brought up being almost devoid of calcareous organisms, but containing abundant spicula of sponges and *radiolaria*.

The light from any self-luminous objects met with should be examined with a prism as to its composition. The colours of animals captured should also be examined with a prism, or by aid of the microscopic spectroscope.

V. *Concluding Observations*

Attention should be paid to the Geology of districts which have not hitherto been examined, and collections of minerals, rocks, and fossils should be made. Detailed suggestions as to the duties of the geologist accompanying the expedition are unnecessary; but it seems desirable that at all shores visited, evidence of recent elevation or subsidence of land should be sought for, and the exact nature of these evidences carefully recorded.

Every opportunity should be taken of obtaining photographs of native races to one scale; and of making such observations as are practicable with regard to their physical characteristics, language, habits, implements, and antiquities. It would be advisable that specimens of hair of unmixed races should in all cases be obtained.

Each station should have a special number associated with it in the regular journal of the day's proceedings, and that number should be noted prominently on everything connected with that station; so that in case of labels being lost or becoming indistinct, or other references failing, the conditions of the dredging or other observations may at once be forthcoming on reference to the number in the journal. All specimens procured should be carefully preserved in spirit or otherwise, and packed in cases with the contents noted to be dealt with in the way which seems most likely to conduce to the rapid and accurate development of the scientific results of the expedition.

A diary, noting the general proceedings and results of each day, should be kept by the scientific director, with the assistance of his secretary; and each of the members of the scientific staff should be provided with a note-book in which to enter from day to day his observations and proceedings; and he should submit this diary at certain intervals to the scientific director, who would then abstract the results, and incorporate them, along with such additional data as may be supplied by the officers of the ship, in general scientific reports to be sent home to the hydrographer at every available opportunity.

The scientific staff should be provided with an adequate set of books of reference, especially those bearing on perishable objects.

SCIENTIFIC SERIALS

A LARGE portion of the *American Naturalist*, for October, is occupied by Prof. Asa Gray's address at the Dubuque meeting of the American Association for the Advancement of Science, to which we have already alluded. Mr. B. Pickman Mann then concludes his paper on the white coffee-leaf miner (*Cemiostoma coffeellum*), a subject of great importance to coffee-growers, treated in an exhaustive manner. Prof. C. F. Hartt, from whom articles on the same subject have already appeared in the *Naturalist*, contributes a further paper on the occurrence of Face-urns in Brazil; and Prof. N. S. Shaler concludes his article on the Geology of the Island of Aquidneck, illustrated by maps and sections; and Mr. C. V. Riley his important article on the cause of Deterioration of Grape-vines.—The November number commences with an article by Mr. J. G. Henderson on some aboriginal relics known as "plummets," which are abundant in various parts of the United States from the Atlantic to the Pacific, with speculations as to their use. Prof. James Orton continues his contributions to the Natural History of the Valley of Quito, the present article being devoted to the Articulata and Plants; in the latter department the author notices the similarity of the features of the flora of the Andes to those recorded by Kerner in the Tyrolese Alps. Mr. R. Ridgway commences some Notes on the Vegetation of the Lower Wabash Valley, with an account of the Forests of the Bottom-lands. Mr. Samuel H. Scudder, in an article on Fossil Insects from the Rocky Mountains, records nearly 40 species, belonging to nearly all the principal groups, found in Tertiary deposits. Prof. Cope, in a paper read at Dubuque, discusses the geological age of the Coal of Wyoming, which he refers without doubt to the Cretaceous period. Prof. Shaler has a short note on the effects of extraordinary seasons on the distribution of Animals and Plants.—In the number for December we find a short article by the Rev. Samuel Lockwood on the Baltimore Oriole and Carpenter-bee, followed by a continuation of Mr. Ridgway's notes on the Vegetation of the Lower Wabash Valley, treating of the Peculiar Features of the Bottom-lands. This is followed by an interesting account of the Alpine Flora of Colorado, by the Rev E. L. Greene; and Dr. J. W. Foster then contributes an abstract of a paper read at Dubuque on certain peculiarities in the Crania of the Mound-builders, illustrated with drawings. Another Dubuque paper of a speculative character is by Dr. H. Hartshorne, on the relation between organic vigour and sex; and Prof. Shaler then gives a further instalment of his paper on the Geology of Aquidneck. In all these three numbers is the usual amount of Reviews, and interesting short paragraphs and notes.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 23.—Dr. Stenhouse read a paper, "Contributions to the History of the Orcins.—No. III. Amido-derivatives of Orcin." He has confined his investigations to an examination of the products obtained from Trinitro-orcinic acid.

Amido-diimido-orcin, $C_7 H_5(NH_2)(NH)_2O_2$.—This compound, which has the properties of a base, is formed by the oxidation of triamido-orcin, and is most conveniently obtained in a pure state by decomposing a solution of the acetate with a slight excess of ammonia. The most advantageous method of preparing the base is to reduce trinitro-orcin with sodium-amalgam, and to oxidise the alkaline solution of triamido-orcin by exposure to the air. Trinitro-orcin is also reduced by treatment with tin and hydrochloric acid, or zinc and hydrochloric or sulphuric acid.

Amido-diimido-orcin hydrochloride.—The hydrochloride obtained in the preparation of amido-diimido-orcin may be purified by crystallisation from hot water; but as heat decomposes solutions of the salts of this base, it is better to precipitate a cold solution of the acetate by a slight excess of hydrochloric acid, in which the hydrochloride is but slightly soluble; the precipitate should be thoroughly washed with alcohol, pressed and dried.

Amido-diimido-orcin sulphate is readily prepared by precipitating a dilute solution of the acetate with sulphuric acid, when it forms minute lustrous plates which are purple by reflected light.

Amido-diimido-orcin nitrate is prepared, like the sulphate, by adding a slight excess of nitric acid to a moderately strong solution of the acetate and washing the precipitate with alcohol.

Amido-diimido-orcin acetate dissolves readily in acetic acid, and on carefully evaporating the solution at a low temperature, the acetate is obtained in ill-defined crystalline plates having a purple iridescence. It is readily soluble in cold water, but only slightly soluble in glacial acetic acid.

Amido-diimido-orcin oxalate.—Very slightly soluble purple scales obtained by precipitating a solution of the acetate with oxalic acid.

Amido-diimido-orcin picrate.—On adding a solution of picric acid to a dilute solution of amido-diimido-orcin acetate and washing the precipitate with alcohol, the picrate is obtained in iridescent green needles and plates. It is insoluble in alcohol, and but slightly soluble in water.

Prof. Owen read a paper "On the Fossil Mammals of Australia.—Part VIII. Family *Macropodidæ*; Genera *Macropus*, *Osphranter*, *Phascolagus*, *Sthenurus*, and *Protemnodon*."

In the present part of the series of papers on the fossil mammals of Australia, the author enters upon the description and determination of the fossils referable to the family of Kangaroos (*Macropodidæ*); restricting, however, the latter term to the species in which the molar teeth have two transverse ridges for the chief character of their grinding-surface, and excluding the Potoroos (*Hipsiprymnidæ*), in which the working-surface of the molars is formed by four tubercles in two transverse pairs. The large extinct species of Kangaroo indicated under the names *Macropus Titan*, *M. Atlas*, and *M. Anak* in former publications here receive further elucidation of their specific distinction from any known living Kangaroos and of the grounds (according to the value assigned thereto by present zoologists) for referring two of these (*M. Atlas*, *M. Anak*) to distinct subgenera of *Macropodidæ*. The author then enters on the elucidation, aided by the facts premised, of *Macropus Titan*, *M. affinis*, *Osphranter Cooperi*, *O. Gouldii*, *Phascolagus altus*, *Sthenurus*, *Atlas S. Brehus*, *Protemnodon Anak*, *P. Og*, *P. Mimas*, and *P. Ræchus*. The maxillary, mandibular, and dental characters of these extinct species are illustrated by the subjects of eight plates.

Zoological Society, January 21, Prof. Newton, F.R.S., V.P., in the chair.—Dr. Günther, F.R.S., exhibited and made remarks on a supposed ancient Egyptian skull.—A communication was read from the Rev. John T. Gulick, containing remarks on the classification of the family *Achatinellinæ*; which he regarded as containing ten well established genera, seven of which were arboreal and three terrestrial in habit.—Mr. A. H. Garrod, read a paper on the visceral anatomy of the Sumatran rhinoceros (*Ceratorhinus sumatrensis*) based on a specimen of this species lately living in the Society's gardens.—Mr. A. D. Bartlett gave an account of the birth of a Sumatran rhinoceros which had taken place on board the *Orchis* at the Victoria Docks on December 7. The mother and an adult male of the animal along with her had been brought from Singapore, but the male had died on the passage. The young one suckled freely and lived for about a fortnight, and was said to have been accidentally killed.—A communication was read from Surgeon-Major Francis Day on some new or imperfectly known fishes of India and Burma.—A communication was read from the Rev. O. P. Cambridge on some new genera and species of Araneidea, chiefly from Mr. Thwaites' Ceylonese collections.—A communication was read from Dr. J. E. Gray containing a description of the skeleton of the New Zealand Right Whale (*Macleayius australiensis*) and of other whales. Dr. Gray concluded with a general list of the known species of the marine mammalia of New Zealand.—A communication was read from Mr. G. B. Sowerby, giving descriptions of several new shells of the genus *Conus*.—A communication was read from Dr. J. C. Cox, containing descriptions of new land shells from Australia and the Solomon Islands.

Anthropological Institute, Jan. 21. Annual general meeting.—Sir John Lubbock, Bart, F.R.S., president, in the chair. The Report of Council showed that the income for 1872 was 1,238*l*. 5*s*. 4*d*., and the expenditure 1,084*l*. 18*s*., leaving a balance in hand of 153*l*. 7*s*. 4*d*.; and that after deducting the expenses of the year, the debt of the Institute had been reduced by 249*l*. 9*s*. 6*d*. The president delivered an address, in which he reviewed the chief anthropological works of the past year by continental and American authors. He also drew attention to the continued destruction of prehistoric monuments, and made further suggestions for their preservation. Prof. George Busk, F.R.S., was elected president.

Meteorological Society, Jan. 15.—Dr. Tripe, president, in the chair. The first paper read was on solar radiation, by Rev. Fenwick W. Stow, M.A. This paper treated of the comparison of the measure of solar radiation obtained by a Herschel's actinometer with that indicated by the difference between the temperature of a blackened bulb *in vacuo*, and that of the air in the shade; the comparison of the latter with the difference of temperature of blackened and unblackened bulbs *in vacuo*; suggestions for a standard solar thermometer or actinometer; errors of thermometers *in vacuo*, and the necessity of comparing them; experiments with blackened bulbs in glass air-jackets; and the objects to be aimed at in investigations of solar radiation, and the importance of such investigations to meteorology and physics. The next paper, also by the Rev. F. W. Stow, entitled "On Temperature in Sun and Shade," was an account of experiments with different thermometers exposed (1) to full sun, (2) to sun, but not to sky in zenith, (3) to sky in zenith, but not to sun, (4) on open thermometer stand, and (5) in louvre board screen. The author found that ordinary mercurial thermometers are affected more by radiation from the ground than from the other sources of heat; and concluded with some remarks on open stands and louvre board screens.—The other communications read were—"On the 'Pocky' Cloud observed July 27, 1872," by J. S. Harding, F.M.S.; "Account of the Hurricane which passed over the Nichol Bay district of Western Australia on March 20, 1872," by R. J. Sholl, Government Resident; and an "Account of a phenomenon observed on board H.M.S. *Fawn*, on May 16, 1872," by H. P. Knevitt.

Institution of Civil Engineers, Jan. 14.—Mr. Thomas Hawksley, president, in the chair. Colonel W. H. Greathed, C.B., R.E., Chief Engineer of Irrigation to the Government of the North-Western Provinces, read a paper "On the Practice and Results of Irrigation in Northern India." The object of the Paper was to describe what had been done and what was now doing in that portion of Upper India where irrigation had been longest practised, and on the largest scale.

GLASGOW

Geological Society, Jan. 9,—James Bryce, LL.D., F.G.S., read a paper on "The Upper Secondary Rocks of Sky and Raasay." After referring to the observations which have previously been published on the Lias and Oolite of Sky, Dr. Bryce noticed the great geological interval which separates these upper Secondary rocks in Scotland from the deposits on which they rest. In the east of Scotland they are found overlying the Old Red sandstone; but in Skye and Raasay their base is formed of the Torridon or Cambrian Sandstone, in a great trough or hollow, in which they seem to have been deposited. He then described at length the general succession of beds observed in Skye, from the lower Lias at Lucy Bay to the middle Lias at Broadford, Pabba, and Raasay, and the upper Lias and inferior Oolite in the neighbourhood of Portree. Passing northwards these were succeeded by beds still higher in the scale, till, at Loch Staffin on the one side, and Uig on the other, members of the upper Oolite were found. He had also found indications of what appeared to be the equivalents of the "Purbeck beds" in England, and the fossils from these were now under careful examination. The paper was illustrated by maps and carefully-prepared sections, together with a tabular view of the beds referred to, and a copious list of the fossils belonging to each horizon, including some new species not yet named.

CALIFORNIA

Academy of Sciences, Dec. 17, 1872.—Mr. W. H. Dall read, "Preliminary Descriptions of new Species of Mollusca from the N. W. coast of America." The *Magasella Aleutica* (Dall, n. s.), has its *habitat* in the Aleutian Islands from Akutan Pass to the Shumagins, attached to the under surface of rocks at extremest low water of spring tides. This pretty species resembles in miniature *Laqueus rubella* of Sowerby, but is proportionately shorter and broader. The animal is rather sluggish. *Acmæa* (*Colisella*) *peramabilis* (Dall, n. s.), inhabits the Shumagin group of islands, Alaska Territory, on rocks near low water mark. This lovely species has no relations with *A. sybaritica*, Dall, and *rosacea*, Cpr., except those of colour. The two latter are much smaller and the rose colour is much lighter and differently disposed. Its nearest allies are some varieties of *A. patina*. *Argonauta expansa* (Dall, n. s.) The interior of the shell is smoothly polished, the exterior, especially on the protuberances of the carinæ, is covered with a multitude of exceedingly minute rough pustules, which give a very rough, harsh feel to the shell, and under a lens appear hemispherical. Laying the shell upon its aperture, with the apex posterior, we have the following measurements. Total length 3·25 in. Width of dorsal area posteriorly 0·32 in.; ditto, anteriorly 0·7. Height of shell 2·0 in. Total extension of axis from end to end, 4 in Total length of aperture 2·25 inches; length from the anterior edge of the spire to the anterior edge of the aperture 1·9 in. *Habitat*, in the Gulf of California. This pretty and peculiar argonaut possesses an assemblage of characters not common to any described species, though there are several which have a somewhat similar lateral extension of the axis.

PARIS

Academy of Sciences, January 20.—M. de Quatrefages, president, in the chair. The President announced the death of M. le Baron C. Dupin, member of the Mechanical Section.—M. Chasles read a paper on the number of points of intersection of two curves of any order at a finite distance.—M. Cahours read a note on certain new derivatives of Propyl. The bodies described were propylic sulphide, mercury propyl, tin propyl, and nitro-propane; the author finds that propylic iodide, which occupies a place between the iodides of ethyl and amyl, behaves like them.—M. A. Trécul read the first part of a paper on the carpellary theory of the *Papaveraceæ*. This part of the paper was devoted to the Papaver family.—An account of some new researches on the tympanic chord, by M. A. Vulpian, followed.—M. A. Dumont sent a paper on the possibility of destroying the Phylloxera in the Valley of the Rhone by submerging the vines.—M. du Pepin sent a note on the residues of the fifth power and one on the quadratic forms of certain powers of the primary numbers.—M. O. Tamin-Despalles sent a note on the connection between ozonometric determinations and the death-rate of Paris. The author finds that the winds from south to north round by west are favourable to health, and that large ozone indications are accompanied by small death-rates.—M. Yvon Villarceau read a letter from M. Borrelly detailing some observations of No. 128, and the discovery of a new variable star. The latter is situated in the Balance; its mean position for 1873 is, $15^h\ 14^m\ 5{\cdot}69^s$ R. A.; $109°\ 55'\ 42{\cdot}7''$ N.P.D.—M. P. Volcipelli sent his fifteenth note on the "Electric Influence."—M. Ch. Viollette sent a note in reply to the late communication of Messrs. Tomlinson and Van der Mensbrugghe on the action of thin films of liquid on supersaturated solutions. He asserts that the ten-atom sodic sulphate crystal always caused the solidification of the solution of that salt, and that it does this of itself, and not by means of its chemical dirtiness.—M. Arm. Gautier sent a note on certain phosphorous compounds, in which that body appears to exist in the amorphous form. The formula for one of these bodies is $P_5\ H_3\ O$; it is formed by the action of water on PI_2.—M. A. Chevalier sent a note on the modifications produced on coloured light by the various tinted glasses used for spectacles. He decides that as the neutral tint alone cuts out the very brilliant red and yellow portions of the spectrum that it alone is of any use.

DIARY

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 8.30.—Note on the Origin of Bacteria, and on their Relation to the Process of Putrefaction: Dr. Bastian.—On Just Intonation in Music: R. H. M. Bosanquet.—On the Composition and Origin of the Waters of a Salt Spring in Huel Seton Mine, with a Chemical and Microscopical Examination of certain Rocks in its Vicinity: J. A. Phillips.

SOCIETY OF ANTIQUARIES, at 8.30.—Oriental Bronze Implements: A. W. Franks.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—Music of the Future: Mr. Dannreuther.

SOCIETY OF ARTS, at 8.—Progress of India during the last Fourteen Years: J. H. Stocqueler.

SATURDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—On Comparative Politics: E. A. Freeman.

SUNDAY, FEBRUARY 2.

SUNDAY LECTURE SOCIETY, at 4.—The Early History of Domestic Animals: L. C. Miall.

MONDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

ENTOMOLOGICAL SOCIETY, at 7.

ASIATIC SOCIETY, at 3.

LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

TUESDAY, FEBRUARY 4.

ROYAL INSTITUTION at 3.—Forces and Motions of the Body: Prof. Rutherford.

SOCIETY OF CIVIL ENGINEERS, at 8.

ANTHROPOLOGICAL INSTITUTE, at 8.—On the Looshais: A. Campbell.—The Inhabitants of Car Nicobar: A. L. Distant.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.—On the Era of Ezra and Nehemiah: Dr. H. Haigh.—On an Assyrian Patera with an Inscription in Hebrew Characters.—Rev. J. M. Rodwell.—Some Remarks upon a Passage in the Pænulus of Plautus: Rev. J. M. Rodwell.

ZOOLOGICAL SOCIETY, at 8.30.—On a certain Class of Cases of Variable Protective Colouring in Insects: B. Meldola.—Report on the Hydroida collected during the Expeditions of H.M.S. Porcupine: Prof. Allman.—Measurements of the Red Blood Corpuscles of Batrachians: G. Gulliver.—Notes on some Reptiles and Batrachians obtained by Dr. Adolf Bernhard Meyer in Celebes and the Philippine Islands: Dr. Günther.

WEDNESDAY, FEBRUARY 5.

LONDON INSTITUTION, at 7.—Fresco and Siliceous Painting: Prof. Barff.

SOCIETY OF ARTS, at 8.

GEOLOGICAL SOCIETY at 8.

MICROSCOPICAL SOCIETY, at 8.—Anniversary.

THURSDAY, FEBRUARY 6.

CHEMICAL SOCIETY, at 8.—On Anthrapurpurin: W. H. Perkin.—On the Solidification of Nitrous Oxide: T. Wills.—On Isomerism in the Terpene Family: Dr. C. A. Wright.

BOOKS RECEIVED

ENGLISH.—Lectures on the Philosophy of Law: J. H. Stirling (Longmans).—The Botanist's Pocket-Book: W. R. Hayward (Bell & Daldy).—The School Manual of Geology. Second Edition: Jukes Browne (A. & C. Black).—History of Bokhara: A. Vambéry (H. S. King & Co.).—Ozone and Antozone: Dr. C. B. Fox (J. and A. Churchill).

FOREIGN.—Reisen in der Phillippen: F. Jager. (Berlin.)

PAMPHLETS RECEIVED

ENGLISH.—National Education and New School Boards: Thomas Bonnar. Quarterly Weather Report of the Meteorological Office, No. 14, Part 2, April to June, 1871.—Journal of the Women's Education Union, No. 1, January, 1873 (Chapman & Hall).—Report of the Kew Committee for fifteen months, ending October 31, 1872.—Quarterly Journal of Science, No. 37, January 1873.—On the Genetic Relation of Cetaceans and the Methods involved in Discovery: Theodore Gill.

FOREIGN.—Zeitschrift fur Meteorologie, No. 1, Vol. viii. January 1873.—Uber den Von Pogson, am 2 December, Aufgefunden der Komete Von Prof. Theodore V. Oppalzer.

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THURSDAY, FEBRUARY 6, 1873

SEDGWICK

GEOLOGY has lost her veteran leader! While yet firm in intellect, full of kind and generous feeling, and occupied on the last pages of the latest record of his labours, in the ninth decad of a noble life, Sedgwick has gone to his rest. Under the shadow of this great loss we look back through more than half a century, and behold no more conspicuous figure in the front ranks of advancing geology than the strenuous master workman, the eloquent teacher, the chivalrous advocate of science, who has now finished his task. Severe illness, borne with fortitude, had gradually withdrawn him from scenes once brightened by his ever-welcome presence, but could not tame the high spirit, or cloud the genial sympathies which had won for him, more than for other men, the loving admiration of his fellows in age and followers in study. Rarely has a patriarchal life been crowned with such enduring and affectionate respect.

Born in 1785, of a family long resident in a secluded Yorkshire Valley under the shadow of Wharnside, the boy early acquired the hardy habits and imbibed the free spirit of the north, and the man retained till his latest hour, a romantic love of the bold hills and rushing streams. amidst which he first became an observer of nature. Every homestead and every family in his native dale of Dent were treasured in his memory, and one of the latest of his minor literary essays was to plead against the change of the ancient name of a little hamlet situated not far from his birth-place.

Educated under Dawson, at the well-known school of Sedbergh, while Gough and Dalton were residing at Kendal, he proceeded to the great college in Cambridge, to which Whewell, Peacock, and Airy afterwards contributed so much renown. Devoted to the Newtonian philosophy, and especially attracted by discoveries then opening in all directions in physical science, he stood in the list as fifth wrangler, a point from which many eminent men have taken a successful spring. He took his degree in 1808, became a fellow in 1809, was ordained in 1817, and for some years occupied himself in the studies and duties of academic life. His attention to geology was speedily awakened, and became by degrees a ruling motive for the long excursions, mostly on horseback, which the state of his health rendered necessary in the vacations.

It was not, however, so much his actual acquirements in geology as the rare energy of his mind, and the habit of large thought and expanding views on natural phænomena, that marked him out as the fittest man in Cambridge to occupy the Woodwardian chair vacated by Hailstone. Special knowledge of rocks and fossils was not so much required as a well-trained and courageous intellect, equal to encounter theoretical difficulties and theological obstacles which then impeded the advance of geology.

The writer well remembers, at an evening *conversazione* at Sir Joseph Banks's, to which, as a satellite of Smith, he was admitted at eighteen years of age, hearing the remark that the new professor of geology at Cambridge promised to master what he was appointed to teach, and was esteemed likely to do so effectually. In the same year Buckland, his friendly rival for forty years, received his appointment at Oxford, where he had previously begun to signalise himself by original researches in palæontology.

At this time the importance of organic remains in geological reasoning, as taught by Smith, was not much felt in Cambridge, where a new-born mathematical power opened out into various lines of physical research, and encouraged a more scientific aspect of mineralogy, and a tendency to consider the phænomena of earth-structure in the light of mechanical philosophy. This is very apparent in the early volumes of the Cambridge Philosophical Society, established in 1819, with Sedgwick and Lee for secretaries. Accordingly, the earliest memoirs of Sedgwick, which appear in the Cambridge Transactions for 1820-21, are devoted to unravel the complicated phænomena of the granite, killas, and serpentine in Cornwall and Devon; and to these followed notices of the trap-dykes of Yorkshire and Durham, 1822, and the stratified and irruptive greenstones of High Teesdale, 1823-24. In his frequent excursions to the north he was much interested in the varying mineral characters and fossils of the magnesian limestone, and the remarkable nonconformity of this rock to the subjacent coal, millstone grit, and mountain limestone; and at length his observations became the basis of that large systematic memoir which is one of the most valuable of the early contributions to the Transactions of the Geological Society. Begun in 1822 and finished in 1828, this essay not only cleared the way to a more exact study of the coal formation and New Red sandstones of England, but connected them by just inference with the corresponding deposits in North Germany, which he visited for the purpose of comparison in 1829.

To one of these equestrian excursions the writer was indebted for his first introduction to Sedgwick. In the year 1822 I was walking across Durham and North Yorkshire into Westmoreland. It was hot summer-time, and after sketching the High Force, in Teesdale, was reclining in the shade, reading some easily carried book. Came riding up, from Middleton, a dark-visaged, conspicuous man, with a miner's boy behind. Opposite me he stopped, and courteously asked if I had looked at the celebrated waterfall which was near; adding that though he had previously visited Teesdale, he had not found an occasion for viewing it; that he would like to stop then and there to do so, but for the boy behind him, "who had him in tow to take him to Cronkley Scar," a high dark hill right ahead, where, he said, "the limestone was turned into lump-sugar."

A few days afterwards, on his way to the lakes, he rested for a few hours at Kirkby Lonsdale to converse with Smith, who was engaged on his geological map of the district, and had just discovered some interesting fossils in the laminated strata below Old Red sandstone, on Kirkby Moor, perhaps the earliest observation of shells in what were afterwards called the upper Ludlow beds. The two men thus brought together were much different, yet in one respect alike: alike in a certain manly simplicity, and unselfish communication of thought. Eight years after this Adam Sedgwick was President of the Geological Society, and in that capacity presented to William Smith the first Wollaston medal. The writer may be permitted the pleasure of this reminiscence, since from the day when he learned the name of the horseman in Teesdale, till within a few days of his death, he had the happiness of enjoying his intimate friendship.

Sedgwick had acquired fame before Murchison began his great career. After sharing in Peninsular wars, and chasing the fox in Yorkshire, the "old soldier" became a young geologist, and for many years worked with admirable devotion to his chief, and carried his banner through Scotland, and Germany, and across the Alps, with the same spirit as he had shown when bearing the colours for Wellington at Vimiera.

Important communications on Arran and the north of Scotland, including Caithness (1828) and the Moray Firth, others on Gosau and the eastern Alps (1829-1831), and still later, in 1837, a great memoir on the Palæozoic Strata of Devonshire and Cornwall, and another on the coeval rocks of Belgium and North Germany, show the labours of these intimate friends combined in the happiest way—the broad generalisations in which the Cambridge Professor delighted, well supported by the indefatigable industry of his zealous companion.

The most important work in the lives of these two eminent men was performed in and around the principality of Wales; Sedgwick, as might be expected, lavishing all his energies in a contest with the disturbed strata, the perplexing dykes, and the cleavage of the lowest and least understood groups of rocks; Murchison choosing the upper deposits exceptionally rich in fossils, and on the whole presenting but little perplexity as to succession and character. One explorer, toiling upward from the base, the other descending from the top, they came after some years of labour (1831 to 1835) in sight of each other, and presented to the British Association meeting in Dublin a general view of the stratified rocks of Wales.

Thus were painfully unfolded the Cambrian and Silurian systems, which speedily became, in a sense, the scientific property of the discoverers, and were supposed to be firmly separated by natural and unmistakeable boundaries. They were, however, not really traced to their junction, though Murchison stated that he had found many distinct passages from the lowest member of the Silurian system into the underlying slaty rocks named by Prof. Sedgwick the "Upper Cambrian;" while Sedgwick admitted that his upper Cambrian, occupying the Berwyns, was connected with the Llandeilo flags of the Silurian system, and thence expanded through a considerable portion of South Wales (Reports of Brit. Assoc., 1835). The Bala rocks were disclaimed on a cursory view by Murchison, the Llandeilo beds surrendered without sufficient examination by Sedgwick; thus the two kingdoms overlapped largely; two classifications gradually appeared; the grand volume of Murchison was issued; and then began by degrees a difference of opinion which finally assumed a controversial aspect, always to be deplored between two of the most truly attached and mutually helpful cultivators of geological science in England:—

> "Ambo animis, ambo insignes præstantibus armis."

This source of lasting sorrow to both, if it cannot be forgotten, ought to be only remembered with the tenderness of regret.

Familiar as we now are with the rich fauna of the Cambrian and Silurian rocks, and their equivalents in Bohemia and America, it is not difficult to understand, and we may almost feel again the sustained enthusiasm which welcomed the discoveries which seemed to reveal the first state of the sea, and the earliest series of marine life, "primaque ab origine mundi," almost to complete the physical history of the earth. Starting with a general view of the structure of the Lake Mountains of the north of England, and the great dislocations by which they have been separated from the neighbouring chains (Geol. Proc. Jan. 1831). Sedgwick won his difficult way through North Wales to a general synopsis of the series of stratified rocks below the Old Red sandstone, and attempted to determine the natural groups and formations (Geol. Proc. May, 1838). Three systems were named in order—Lower Cambrian, Upper Cambrian, Silurian—the working out of which, stream by stream, and hill by hill, worthily tasked the energies of Ramsay and his friends of the National Survey for many useful years, after increasing ill-health had much reduced the field-work of the Professor.

But now he began to labour more earnestly than ever in the enlargement and setting in order of the collections which were under his personal charge. In 1818, these consisted almost wholly of the small series bequeathed by Dr. Woodward; now they have been expanded by the perpetual attention and generosity of Sedgwick, into one of the grandest collections of well-arranged rocks and fossils in the world. One of the latest acquisitions is the fine cabinet of Yorkshire fossils, purchased by Cambridge as a mark of loving respect for her great teacher in his fast decaying days.

In this work of setting in order a vast collection gathered from various regions, and from all classes of deposits, Prof. Sedgwick, with wise liberality, engaged the willing aid of some of his own pupils, and of other powerful hands brought to Cambridge for the purpose. Ansted, Barrett, Seeley, M'Coy, Salter, Morris, have all helped in this good work, and to their diligence and acumen were added the unrivalled skill and patience of Keeping, one of the best "fossilists" in Europe. Those who in this manner have concurred in the labours of their chief, one and all found in him the kindest of friends, the most considerate of masters—one who never exacted from others, and always gave to his assistants more than the praise and the delicate attention which their services deserved.

The ample volumes entitled "British Palæozoic Rocks and Fossils, 1851-5," by Sedgwick and M'Coy, must be consulted for a complete view of the classification finally adopted by Sedgwick; and further information is expected from the publication of a Synoptic Catalogue, to which Salter gave some of his latest aid.

Never was a man so universally welcome among the members, and especially the junior members of his own university. Wonderful was the enjoyment of a voyage to Ely with a happy crew of his pupils (1850). If one stopped at Upware, the oolite there uplifted became the topic of an amusing and instructive discourse; the great cathedral was visited in a more serious mood; the shores rang with the merriment of the returning boat; and the evening closed with a joyous banquet in the hospitable college rooms.

During his long tenure of a Fellowship in Trinity College, Prof. Sedgwick witnessed great changes in the mathematical training, and contributed as much as any man to the present favourable condition of Science in Cambridge.

To defend the University against hasty imputations, to maintain a high standard of moral philosophy, and a dignified preference for logical induction to alluring hypothesis was always in his thoughts. Hence the "Discourse on the Studies of the University of Cambridge," at first an eloquent sermon, grew by prefix and suffix to a volume which he himself likened to a wasp—large in front and large behind, with a very fashionable waist.

Under such feelings he spoke out against the "Vestiges of Creation" with a fervour of argument and declamation which must have astonished the unacknowledged author of that once popular speculation. Nor was he silent when the views of Darwin came to fill the void places of biological theory, against which he not only used a pen of steel but made great use of his heavy hammer.

The vigour—vehemence we may call it—of his pen and tongue in a matter which touched his sense of justice, morals, or religion, might mislead one who did not thoroughly know his truth and gentleness of heart, to suppose that anger was mixed with his honest indignation—

ου γαρ μειλιχος εσκε . . . εν δαϊ λυγρῃ

But it was quite otherwise. In a letter addressed to the writer, in reply to some suggestion of the kind, he gave the assurance that he was resolved "no ill blood" should be caused by the discussion which had become inevitable.

He never failed in courtesy to the honest disputant whose arguments he mercilessly "contunded." Taken altogether, Professor Sedgwick was a man of grand proportion, cast in a heroic mould. Pressed in early life through a strict course of study, he found himself stronger by that training than most of his fellow geologists, but never made them feel his superiority. Familiar with great principles, and tenacious of settled truths, he was ready to welcome and encourage every new idea which appeared to be based on facts truly observed, and not unprepared or unwilling to stand, even if alone, against what he deemed unfair objection or unsubstantial hypothesis.

This is not the place to speak of his private worth, or to indulge in reminiscence of his playful and exuberant fancy, the source of unfailing delight to those who knew him in his happier hours. Unmarried, but surrounded by plenty of cheerful relatives, his last hours of illness were soothed by sedulous affection; his kindly disposition no suffering could conceal; his lively interest in passing events nothing could weaken. Ever

"Against oppression, fraud, or wrong,
His voice rose high, his hand waxed strong."

With collected mind, on the verge of the grave, he would express, with undiminished interest, his latest conclusions on his own Cambrian system, purely as a matter of scientific discussion, free from all personal considerations. It will be well if this mode of treatment be reverently followed by those who while speaking of Protozoic and Palæozoic Rocks, know enough to feel how much they have been benefited by the disinterested labours of a long and noble life.

JOHN PHILLIPS

PALMIERI'S VESUVIUS

The Eruption of Vesuvius in 1872. By Prof. Palmieri, Director of the Vesuvian Observatory. With Notes and an Introductory Sketch, &c. By Robert Mallet, F.R.S. (London: Asher and Co., 1873.)

THAT, in these days of rapid intercourse, the re-appearance of volcanic phenomena on the large scale in any part of the earth's surface should awaken a far more than mere local interest, was well illustrated in the case of the late great outbreak of Mount Vesuvius, during the continuance of which the telegraphic bulletins received from the fiery mountain became the subject of general inquiry and discussion in all parts of the civilised world; and even now that the eruption has entirely subsided, the publication of a translation by Mr. Mallet, of the report of the well-known Italian *savant*, Professor Palmieri, entitled "Incendio Vesuviano del 26 Aprile, 1872," will be welcomed as a valuable contribution to English scientific literature quite independently of its being a book likely to secure numerous readers amongst the non-scientific public also.

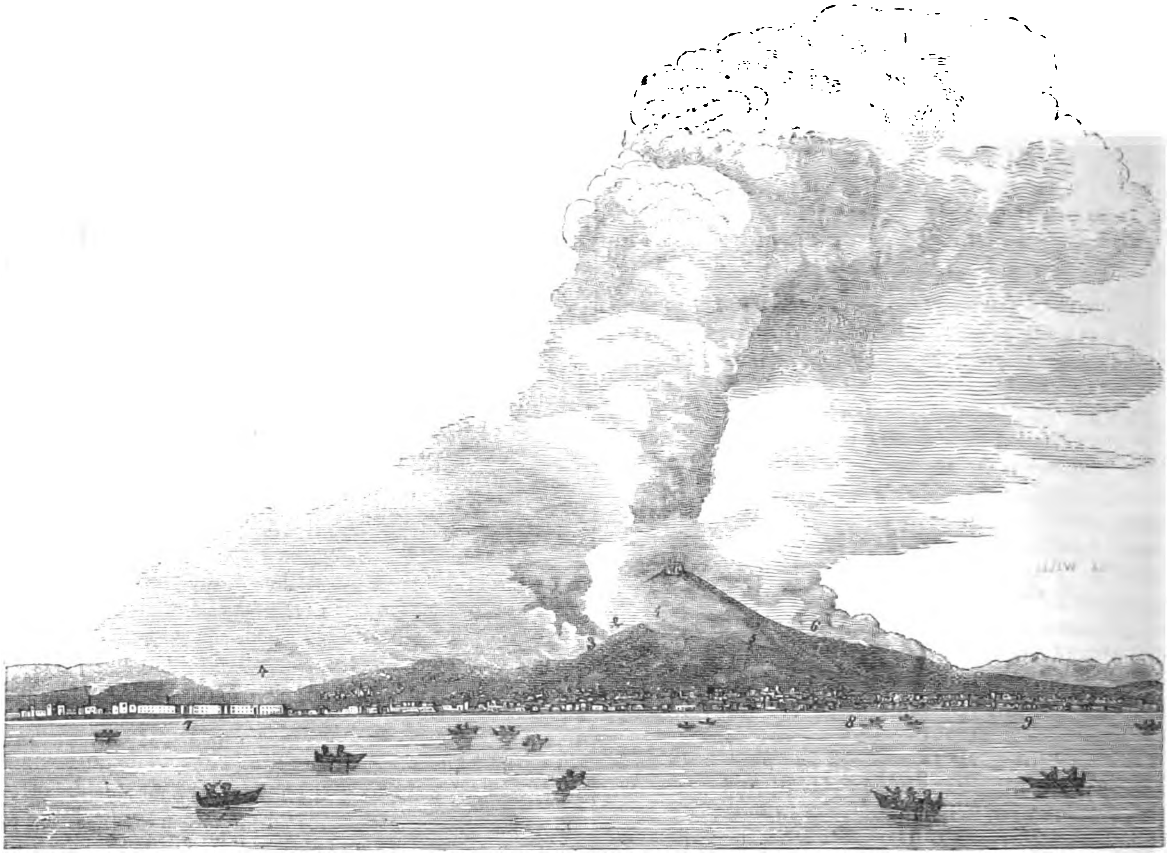
This report of Professor Palmieri, who so courageously stuck to his post in the Observatory on the side of Mount Vesuvius, when that building actually stood between two torrents of liquid fire, the heat from which cracked the glass in the windows and even scorched the very habitation itself, is one of the most important records of volcanic phenomena which we possess. Written in the most unassuming style, it does not go into theoretical points, but confines itself all but entirely to recording such facts as were considered by its author to be important or interesting from a scientific point of view, alluding only incidentally to the destruction caused by the lava and ashes on the morning of April 26. In point of fact it is to be regarded as a scientific rather than a popular description of the eruption. Although the professor specially excels in details, the main features of the different phases of the eruption are well described, and a vivid impression of the enormous force developed on such occasions is conveyed by his observation that on April 26 the volume of smoke, ashes, lava fragments and bombs projected upwards from the crater attained a height of no less than 1,300 metres (4,265 feet) above its edge.

The report itself contains a mass of data calculated to be of invaluable assistance in the future investigation of volcanic phenomena, and although it may be said that the conclusions arrived at from the study of this eruption, do not present us with any strikingly new or startling deductions, their great value lies in the corroboration or correction of those resulting from previous observations. Amongst these may be mentioned, the opinion now held by the professor, that to a certain extent eruptions may be predicted, which he bases upon the observations that when the central crater commences to be agitated, this is followed by a series of slight convulsions which terminate in a grand outbreak or eruption, after which the volcano first settles down again into a state of repose; the evidence brought forward to prove the crystallisation of the leucite out of the fluid lava and against its pre-existence in it, as has been assumed by some previous writers; the order of appearance of the acid vapours; the constant presence of certain metallic compounds and sublimates;

and the respective electrical conditions of the smoke and ashes.

The report is illustrated by eight plates of the instruments employed at the Vesuvian observatory, and of views of the eruption in its different stages, which latter, however, as is frequently the case when taken from photographs, cannot be regarded as altogether satisfactory; the translation is done with evident care, but the nomenclature is open to objections, especially when such terms as sulphide of potash and ferrochloride of ammonia are encountered.

The introductory sketch by which the translation is prefaced, occupies 90 out of 148 pages, and must be regarded as quite a distinct treatise, being only indirectly connected with the report on Vesuvius; and its style, which cannot be regarded as an agreeable one, is not very gracious to the labours of the many eminent men who have preceded or now hold views differing from those of the author. Although brought forward as representing the present state of knowledge of terrestrial vulcanicity, we find no reference to any of the continental men of science, who have done so much in this direction, and it should be more correctly entitled an exposition of the author's views on seismology and what he terms vulcanology, the first 46 pages being but an abstract of his previously published investigations into the phenomena of earthquakes.



Vesuvius, on April 26, 1872, from a Photograph. 1 The Observatory.—2. Fossa della Vetrana. 3. Eruption of Smoke and Ashes, with Stones, from the Surface of the Lava. 4. The Novelle, St. Sebastiano, and Massa. 5. Lava which took the direction of Resina. 6. Lava which, from the Crater, took the direction of the Camaldoli 7. The Grain Stores, near Naples. 8. Resina. 9. Torre del Greco. 10. The Camaldoli.

The second part of this sketch is a *résumé* of the main features of Mr. Mallet's dynamical theory of volcanic energy, published in the Proceedings of the Royal Society for 1872, a hypothesis which explains volcanic action as originating in the secular cooling of our globe, when, to use the words of the abstract, "As the solid crust sinks together to follow down after the shrinking nucleus, the work expended in mutual crushing and dislocation of its parts is transformed into heat, by which, at the places where the crushing sufficiently takes place, the material of the rock so crushed, and that adjacent to it, are heated even to fusion. The access of water to such points determines volcanic eruption." To one who, like Mr. Mallet, assumes that heat, and heat alone, is in the first instance all that is required to account for the varied phenomena of volcanic activity, this explanation may appear satisfactory enough, although even if it be proved experimentally that the intensity of the heat thus produced in such cracks of contraction, or faults, as a geologist would probably term them, is sufficient to fuse the substance of the rocks in immediate contact, it would nevertheless be found even still more difficult to account for the quantity of heat requisite to melt up such vast volumes of rock matter as are known to proceed from volcanoes. Allowing, however, that even this difficulty can be satisfactorily explained away—and it is admitted that the conversion of the mechanical force into heat is sufficient to effect the melting part of the operation—there remains the still greater difficulty of explaining the chemical and mineralogical features which characterise volcanic phenomena. For although mechanical force is admitted to be convertible into its equivalent in heat, which heat may in its turn set in operation chemical action, still no such forces, either alone or combined, can transmute one chemical element into another, or bring about the formation of products having at all times a definite chemical and mineralogical constitution, out of the incongruous materials likely to be met with on the sides of such faults, or cracks, or contraction. Our present knowledge of the mineral characters of the earth's crust does not entitle us to entertain the supposition that the substance of the rocks immediately contiguous to fissures of this character occurring in so many different parts of the globe, could in all, or even in other than solitary instances, when fused by the action of mere heat, afford products identical with those of known volcanoes. On the other hand, nothing is more certain, from the examination of volcanic products, than that, no matter from what part of the world they be derived, whether from volcanoes situated near the north or south poles, in the islands of the Pacific or Atlantic oceans, or from the craters of the Andes or the Apennines, they are all identical in chemical or mineralogical constitution—a result which indicates forcibly that that they must be derived from some one common source, and not be mere local accidents, as Mr. Mallet's hypothesis would require us to assume. For these and other reasons which we need not bring forward on the present occasion, it does not seem probable that this hypothesis will receive the adherence of either chemist, mineralogist, or geologist.

In conclusion, attention might here be directed to the disadvantages which, in a pecuniary point of view, the British student labours under when making himself acquainted with foreign science by means of translations. The original pamphlet of Prof. Palmieri in Italian, and its translation into German by the eminent chemist, Rammelsberg, were procured here in London for the small sum of eighteenpence each, whereas English translations of scientific works, got up, however, in superior paper, wide margin, and elaborate covers, can rarely (if ever) be obtained under several times the cost of the original works.

DAVID FORBES

OUR BOOK SHELF

Human Physiology the Basis of Sanitary and Social Science. By T. L. Nichols, M.D. Pp. 479; woodcuts. (Trübner, 1872.)

THE title "Human Physiology," which alone appears on the back of this book, is misleading, and even the title as given above would scarcely prepare a reader for what he will find. The preface, however, gives fair warning. "Physiology," writes Dr. Nichols, "the science of life, has been handed over to the medical profession, which has an unfortunate interest in the popular ignorance of sanitary laws; while metaphysicians, moralists, and theologians have confused rather than enlightened our ideas "as to the moral nature of man and his consequent social requirements." This seems rather hard on the doctors, who have certainly done all that has yet been done in preaching the laws of health and in getting them carried out, both by public supervision or compulsion and by private influence; but the whole volume is an exemplification of the latter part of the melancholy result, whether due to those designing persons who study metaphysics, morals, and theology or to some other cause. Dr. Nichols is an ardent advocate of the numerous theories which blind and bigoted Science has consistently and universally refused to accept, to the great disgust of circle-squarers, anti-Newtonians, popular "scientists," and Social-Science-mongers. The first section of the book treats of preventible mortality, poverty, ignorance, drunkenness, and prostitution; the second of matter, force, and life, including adverse criticism, on the feeblest grounds, of the doctrines of evolution and of materialism, with some remarkable "proofs of immortality." The third part gives a popular account of the human body, with some of the oddest illustrations ever printed. The fourth treats of the laws of generation, including chapters on love and marriage, hereditary transmission, and problems of the sexual relation. This section is, perhaps, the best in the book, and its subjects are handled with freedom and modesty, while the conclusions are sensible enough. The fifth, part on health, disease, and cure, contains a good many useful and obvious remarks on the value of cleanliness, exercise, and temperance, together with a number of utterly unsupported or demonstrably false propositions. The last part, is devoted to the discussion of morals and society, in which important questions in political economy, ethics, agriculture, are stated, benevolent wishes for all classes of mankind are expressed, and the questions left much as they were found.

In a book of this kind the reader is not surprised to encounter the old and new dogmas of phrenology, vegetarianism, clairvoyance, homœopathy, animal magnetism, anti-vaccination, and cure by Psychic force. But though unscientific and sometimes anti-scientific, the author would deserve credit for putting before the public information which, however trite, is too little acted on, if his assertions of the wonderful cures he has made by hydropathy at Malvern, and the quotation from "a little book," by Mrs. Nichols on the same subject, did not suggest a doubt whether in his case singleness of motive can be admitted in excuse of ignorance.

P. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Dr. Bastian's Experiments

MR. LANKESTER asks me several questions relating to the experiments by Dr. Bastian, reported by me in NATURE a few weeks ago. In reply I beg to say that new Cheddar cheese was used. The cheese was not weighed, but the quantity added to the contents of each flask probably did not exceed two grains. The turnip infusion was filtered before it was introduced into the flasks: the filtrate was limpid. After boiling, the liquid was somewhat turbid, and contained visible particles.

Feb. 3 J. BURDON SANDERSON

Eyes and No Eyes

MR. RAY LANKESTER's letter has reminded me of a little experiment of my own which converted me to Bastianism. I had some turnip and cheese flasks which Dr. Bastian had been kind enough to prepare in my presence. I took them home and in due time examined the contents in a good microscope, using what I thought adequate power. I saw nothing, and went triumphant to Dr. Bastian to report my failure, taking the flasks with me. Dr. Bastian looked at the fluid, smelt it, and told me he would eat his hat if it was not full of life. I thought he would have to eat his hat. He put a drop under his microscope and told me to look. It was full of small Bacteria. I was a good deal puzzled at first, but after a little discussion I found out why I had failed to see what was in the fluid. Without going into details, I may say that the short result was that I had been rather a muff with the microscope. May not this explain some other failures?—not Mr. Lankester's, of course.

QUERY

Meteor at St. Thomas

THE enclosed reached me from a meteorological correspondent in St. Thomas. The records of such phenomena must be rare; there may be something peculiar in this one; I therefore forward it to you.

RAWSON RAWSON

Government House, Barbados, Dec. 30, 1872

"On November 30, 1872, at $8^h\ 10^m$ P.M. a beautiful large meteor was observed, which passed from west to east with great brilliancy, and exploded in the zenith in numerous little stars. It lasted about three seconds. A little after a rumbling noise, like distant thunder, was heard. It is reported by the watchman of the floating dock, which lies at present on the eastern beach of Long Bay in eight feet water, for repairs, that he was sleeping on the platform under an awning; he awoke from the heat and the strong light which passed close to him through the lattice work; and some ashes fell on the dock which he found but did not collect, not knowing that it was of value. As is well known, aerolites travel at the rate of 10,000 feet per second."

Brilliant Meteor

LAST night about 10.0, the moment after leaving the room in which I had been lecturing, at Wordsley, near Stourbridge, the ground about me was lighted up as by the sudden flash of a near lantern or the emergence of the full moon from a bank of cloud. On looking up at the sky, I saw a rocket-like object shooting down with a slightly zigzag motion like that of a fish, and leaving behind it a trail of mingled and mingling tints of green, purple, and yellow of nearly the semi-diameter of the moon. After a first thought about fireworks, I felt sure it was a meteor, and looked about for the constellations, so that I might be able to describe its path. The sky, however, was covered with clouds, only a star here and there being visible, and the moon, though easily seen, presenting a very hazy appearance. From inquiry at the Rectory as to the aspect of the schoolroom from which I had just come out, I judge that the course of the meteor must have been from north-west to west. When I first saw it, it was about 40° or 50° above the horizon, and it traversed about half the remaining space before disappearing, occupying, I estimate, about six seconds in doing so. Its path formed an angle of about 40° with the horizon.

From the fact that the sky was covered with clouds and that the meteor illuminated the ground with a light superior to that of the "half" moon shining at the time, I judge that the meteor was between the clouds and the earth. This nearness, would, of course, be an element in its great apparent size (which would be added to by the zigzag motion); and as it would also prevent its being seen at great distances and by many observers, I have, after some hesitation, penned this record of my very imperfect observations.

GEORGE ST. CLAIR

London, Feb. 4

The Antinomies of Kant

MY attention has been directed by a friend to an address by Prof. W. K. Clifford, in *Macmillan's Magazine* for this month, containing a curious misrepresentation of Kant's teaching, and therein an instructive instance of *ultracrepidism*. The professor remarks: "The opinion that at the basis of the natural order there is something which we can know to be *unreasonable* to elude the process of human thought . . . is set forth first by Kant, so far as I know, in the form of his famous doctrine of the antinomies or contradictions, a later form of which I will endeavour to explain to you." "This doctrine," he continues, "has been developed and extended to the great successors of Kant, and this unreasonable, or unknowable, which is also called the absolute and the unconditioned, has been set forth in various ways as that which we know to be the true basis of all things."

I am sure I should not be allowed, in the columns of NATURE, sufficient space to point out in detail the misapprehensions involved in these remarks. It is plain to me that Professor Clifford has approached the very difficult subject of Kant's Antinomies from the system of Sir William Hamilton. To start with Hamilton, however, is to be handicapped in the pursuit, and to augment the difficulties to be surmounted. In truth the doctrine Professor Clifford expounds is simply that of Hamilton; but Hamilton did not either develop or extend the Antinomies of Kant. He never understood them, but carved his little system out of a few splinters he gathered by the way. All Hamilton's characterisations of Kant are ludicrously false. This doctrine of the Antinomies does not answer, either, to Professor Clifford's touch. The Antithetic is not "*unreasonable*," nor does it "elude the processes of human thought;" for, though it presents an unavoidable *illusion*, Kant has used reason, with matchless power and subtlety, to show that reason is master of the position, can solve every Antinomy, and can therefore guard against the very possibility of delusion. It is not any "natural order" of thought or things, that is found to be unreasonable, but the offence against *common logic* which is involved in every attempt to prove the thesis or antithesis of an antinomy. I refer all who care to see the thing for themselves to Kant's K. r. V., Element. ii. Th., ii. Abth., ii. Buch., 2 Hauptst., 7 Abschnitt: Kritische Entscheidung des kosmologischen Streits der Vernunft mit sich selbst: *et seq.*

C. M. INGLEBY

Athenæum Club, Jan. 21

The Source of the Solar Heat

IT gave me great pleasure to find that Captain Ericsson has taken the same views as myself with regard to the Source of the Solar Energy; but there is a certain part of his article in NATURE, vol. vi. p. 539, which I do not quite understand.

My views on this subject were sent to the Royal Astronomical Society, and were published in the Monthly Notices for April 1872, where it was easily shown that if E be the total energy destroyed in a given time by the crushing-in of the sun's mass—

$$E = \tfrac{4}{3}\pi g_0 \rho z_0 r_0^3$$

where g_0 is the force of gravity at the sun's surface,

ρ the density, supposed constant,

r_0 the sun's radius,

z_0 the contraction of that radius in the given time; all corresponding to the present epoch.

To find z_0 we must express E in thermal units by means of the dynamical theory of heat, and equate the result to the total amount of heat radiated by the sun; and it is easy to show that z_0 must be 129 ft. per annum; and since Captain Ericsson finds the contraction to be 121 ft., we are so far in agreement.

But $\frac{4}{3}\pi\rho r_0^3$ is the mass of the sun, and g_0 varies inversely as r_0^2, hence we may write

$$E = \frac{CZ}{R^2}$$

where C is a constant, and R, Z, the values of the radius and of the contraction at any other epoch of time. Now there is no connection between Z and R; if Z varies as R^2, then E is constant; if Z varies as R, which I believe to be the most probable assumption, then E varies inversely as R, and the total solar radiation must be slowly increasing; but I see no reason whatever for supposing that Z varies directly as R^4, so that the solar radiation must be diminishing in proportion to the square of the sun's radius.

MAXWELL HALL

Jamaica

The Twinkling of the Stars

THE phenomenon observed and described by G. F. Burder in NATURE of Jan. 23, p. 222, does not, as I understand it, account in any way for the twinkling of stars, seeing that, by means of any two lights (gas lamps for instance) at the distance of a few hundreds of yards, the same effect may be observed, and this quite irrespective of the angle at which they are placed with reference to the horizon or the "blind spot" of the observer's eye.

THOS. HAWKSLEY

Meteorological Cycles

THE following observation may possess some interest in connection with the subject of recurring meteorological cycles. It is found at the conclusion of Mr. Consul Wallis's report on the trade and commerce of Costa Rica for 1867, dated June 1, 1868 (Parliamentary Papers for 1868-69, vol. lix. p. 520):—"In the state of the public health there is a marked and satisfactory improvement to report. No reason can be assigned here for the large number of epidemic disorders which have afflicted this country for the last *ten* years and since the visitation of the cholera, nor for the improvement which took place in the *eleventh* year."

R. G.

London, Jan. 2

ON THE OLD AND NEW LABORATORIES AT THE ROYAL INSTITUTION[*]

II.

OF the next great name connected with our Institution, namely, Michael Faraday, of his life and his discoveries the history has been already written, so far indeed as it can be written, by Bence Jones, by Tyndall, and by Gladstone. *Si monumentum quæris circumspice.* These volumes of notes, from 1831 to 1856, will give some idea of the amount of work which he did in our laboratory; and their value will be better appreciated through the consideration that before these notes were made, no less than sixty of his scientific papers had been printed, nine of them in the "Philosophical Transactions"

Those of us who were present at Tyndall's two memorable lectures on "Faraday as a discoverer" are not likely to forget the impression of the man left by them on our minds; and for those who were not present it would be an office thankless to your lecturer and burdensome to his hearers, to contribute a feeble reproduction of those life-like memoirs, For our present purpose it will be sufficient to say that the entire fabric of those brilliant and manifold contributions to human knowledge was wrought out within the walls of the Royal Institution.

His great experiments have been so often and so well exhibited in this theatre, that some apology is needed for bringing any of them before you again; but in repeating for my own instruction some of those which bear more particularly upon the subject of Light, I have been tempted to reproduce one of them here. In doing this I I have been perhaps moved more by a fascination of the phenomenon, and by a piece of instrumental good fortune which enables me to introduce an old friend under a new garb, than by any better reason. The experiment in question is that which Faraday called "the magnetisation of light, and the illumination of the lines of magnetic force;" we should now term it the rotation of the plane of polarisation under the influence of the magnetic field. And in order that we may not even by inadvertence confuse the rotation here produced with that due to quartz, or oil of turpentine, I will draw your attention, by way of memorandum, to the nature of the magnetism produced by spiral currents in given directions, and of the rotations of free currents produced by magnets.

[The lecturer then showed the opposite rotations of two sparks discharged about the two poles respectively of an electro-magnet, and the reversal of those rotations, first by a change of the poles, and secondly by a reversal of the direction of the sparks.]

You now see upon the screen an image of the figures produced by a magnificent piece of heavy glass under the action of polarised light. Its size enables me to make use of about four times the amount of light usually available in this experiment; and I have taken advantage of the figure which its imperfect annealing produces, to vary the effect upon the screen. The dark parts of the figure indicate the parts of the beam in which the vibrations are perpendicular to those transmitted by either polariser or analyser, and which are consequently cut off. Now if anything should intervene to change the plane of those vibrations a portion of them will be transmitted, and a partial illumination of the screen will ensue. This turning of the plane of vibration is effected by the magnet as soon as its force is developed by the electric current sent through its coils.

[The lecturer then "dispersed" the dark lines of the figure by means of a plate of quartz; and after turning polariser and analyser so as to colour the centre of the field with the tint intermediate between red and violet (*teinte sensible*), he showed that when the magnet was excited the field was rendered red or green according to the direction of the poles.]

Professor Frankland before coming to us had isolated the compound radicals Methyl, Ethyl, and Amyl, and had proved their resemblance to Hydrogen. He had also combined them with the metals zinc, tin, mercury, and boron. By this means he had obtained a very powerful chemical reagent, which proved of eminent service in subsequent operations. An instance of its power will be found in zinc—ethyl, which by its rapid combination with oxygen of the air, bursts into spontaneous combustion as soon as a flask containing it is opened.

In conjunction with Mr. Duppa, Prof. Frankland worked in our laboratory at the artificial formation of ethers. They treated acetic ether with iodine and with the iodides of methyl, ethyl, and amyl; and by their means they arrived at a method for the formation of many organic substances which had previously been obtained only through the agency of animals or of vegetables.

In 1866 Dr. Frankland determined by a long series of calorimetric experiments the maximum amount of force capable of being developed by given weights of the different foods commonly used by men.

In the following year he investigated the effect of pressure (up to 20 atmospheres) upon the luminosity of flames of hydrogen and of carbonic oxides. He found that these flames, so feebly luminous at ordinary atmospheric pressure, burn with brilliant light under pressures of from 10 to 20 atmospheres, and that the spectra of these brilliant flames are perfectly continuous. From the latter circumstance he infers that solar light may be derived from glowing gas and not from incandescent solid or liquid matter.

As these researches have so important a bearing upon spectral analysis and solar physics, I will venture to repeat one or two of the experiments. Here are three closed tubes filled respectively with hydrogen, oxygen, and chlorine, at atmospheric pressure. The densities of these substances are in the proportions 1 : 16 : 35½; and if the spark from an induction coil be made to pass through them, the luminosity of the discharge will be found to be nearly in the same proportions. That this result is really due to the density, and not to the chemical constitution of the gases, may be proved by allowing the discharge to pass through this tube, and by pumping air into it during the discharge. It will then be seen that the brilliancy increases with the pressure.

These researches were suggested by an old experiment of Cavendish's, in which he exploded a mixture of oxygen and hydrogen, first under atmospheric pressure and then under a pressure of from 10 to 12 atmospheres. In the first case there is much noise and little light; in the second, a brilliant flash and no noise. The labours of Dr. Frankland have rendered this experiment intelligible, and have correlated it with other phenomena.

Of Dr. Frankland's successor, Dr. Odling, I should have had more to say, had he not been attracted by a well-deserved offer of the chemical chair at Oxford. As a member of that University I rejoice at the appointment, while here we regret the loss.

Of Faraday's successor, John Tyndall, I am greatly at a loss how to speak. In this place his presence seems so near to us, his thoughts so subtle, his words—even when rung back to us from those busy cities far away on the other side of the Atlantic—so familiar and yet so stirring, that it behoves us that ours should be wary and few. Few men have brought so large a burden and bulk of contribution to the common stock of knowledge; but still fewer have inspired in his hearers so strong a love, such ardent enthusiasm for the subjects of his research.

It is now twenty years since Prof. Tyndall began his researches in our laboratory. During the first thirteen years he produced no less than thirteen papers, which were printed in the "Philosophical Transactions:" on Sound, on Diamagnetism, on Glaciers and Ice, on the

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[*] Continued from p. 224

Radiation and Absorption of Heat, and on Calorescence. In these he established the important fact that if the various gases be arranged in order according to their power, first of radiating heat, and secondly of absorbing radiant heat, the order will be the same in both cases. He further proved that the chief absorbing action of our atmosphere on non-luminous heat is due to its aqueous vapour. He applied his discovery to the explanation of many meteorological facts : *e.g.* the great daily range of the thermometer in dry climates ; the production of frost at night in the Sahara ; the cold in the table-lands of Asia, &c.

He discovered also the means of separating the invisible from the visible radiations, and proved that in the case of the electric light the former is no less than eight times as powerful as the latter. He also made the daring experiment of placing his eye at a focus of dark rays capable of heating platinum to redness.

Since 1866 his attention has been largely occupied in examining the action of heat of high refrangibility (instead of low), as an explorer of the molecular condition of matter.

In this investigation one obstacle to be overcome was the presence of the floating matter in the air. The processes of removal of these particles became the occasion of an independent research, branching out into various channels ; on the one hand, it dealt with the very practical problem of the preservation of life among firemen exposed to heated smoke ; and, on the other, it approached the recondite question of spontaneous generation.

He subjected the compound vapours of various substances to the action of a concentrated beam of light. The vapours were decomposed, and non-volatile products were formed. The decompositions always began with a blue cloud, which discharged perfectly polarised light at right angles to the beam. This suggested to him the origin of the blue colour of the sky ; and as it showed the extraordinary amount of light that may be scattered by cloudy matter of extreme tenuity, he considered that it might be regarded as a suggestion towards explaining the nature of a comet's tail.

[The lecturer then exhibited the polarisation of light scattered by small particles suspended in the medium traversed by a beam from the electric lamp, employing for the purpose the chromatic effects due to the circular porlarisation of quartz.]

His volume of contributions to molecular physics in the domain of radiant heat, which contains only his original investigations on this subject, would alone suffice to show what is doing in the laboratory of our Institution.

If we compare him to Faraday at the same time of life, he has still many years of intellectual energy, the conversion of which into its scientific equivalent may, perhaps, be effected within these walls.

No one has regretted the destruction of the laboratory of Davy and of Faraday more than Prof. Tyndall. He almost prayed for the preservation of the place where their discoveries had been made ; but as soon as he saw that in our struggle for existence such material aids as improved buildings would conduce alike to the progress of science and to the permanence of the Institution, he withdrew his objections, and threw all his powers into making the new laboratories as perfect as possible for the good of his successors.

I add a few words on the reasons which led the managers to recommend the rebuilding of our laboratories, and the consequent demolition of the place where the great discoveries that I have touched upon were made. In the opinion of those best qualified to judge, our chemical laboratory was badly ventilated, badly lighted, badly drained, and quite unfit to be occupied for many hours daily. It was probably the very worst, and certainly all but the worst chemical laboratory in London ; and compared with more modern ones both at home and abroad, it was nowhere. The physical laboratory had remained for nearly seventy years in its original state. At first it was said to be equal to any laboratory ; but then there were hardly any in existence in this country ; and during the last few years such splendid edifices have arisen in London, in Oxford, in Cambridge, in Manchester and in Glasgow, and elsewhere, that the laboratory of Davy, of Faraday, and of Tyndall was much inferior to the private laboratories of the professors who carry on their course of instruction in public rooms of still greater size and extent of resource. The main purpose of our laboratories is research, and instead of offering by their excellence an inducement to professors to come and to stay, the one was a makeshift, the other a noble relic. Neither afforded facilities which were not offered in a larger measure elsewhere. And those only who know what is going on both at home and abroad can form an adequate idea of the competition which, in this respect alone, will prevail for a generation to come.

By the construction of new laboratories this material disadvantage will be removed. Future professors will have buildings constructed to aid research. Your liberality has spared no judicious expense ; and, so far as the site would admit, our laboratories will be as perfect as the skill of our architect and the advice of our professors can make them.

In conclusion, let me lay before you what must still be done, in order that there may be earned for the new laboratories a reputation comparable with that which has hitherto proved both our glory and our support.

Our first and foremost object, beyond bricks and mortar, and money, and apparatus, must be to find a succession of professors of the old type ; men who love research. But even Faraday would perhaps have been compelled to leave us, on account of the smallness of the sum which we could afford him, had not the endowment of the chemical chair, with 100*l.* a year, by the late Mr. Fuller, happily intervened. This timely endowment was probably a critical turning point in the history of the Institution. We may not easily find successors worthy of the great names who have gone before them ; but we may do much toward preventing mistakes in future appointments by keeping steadily in view, that the promotion of natural knowledge is our main object ; and that instruction and amusement, and brilliant audiences are all secondary to our principal purpose. Not that these subsidiary purposes are to be neglected or despised ; and I, as your Treasurer, should be the last to undervalue them, but we feel confident that if the main purpose is effected, all the others will follow as a simple sequence.

Secondly, when we have found professors of the type that I have described, our next need is that we may be able, from independent resources at the disposal of the Institution, to offer them a remuneration which, all things taken into account, shall be an equivalent to what they would receive elsewhere. So that neither Government appointments, nor University professorships, nor the liberality of mercantile men, should be able to lure them from the path of discovery, to tuition, to arts, or to manufactures.

The one act of wisdom, among the many aberrations of an eccentric member of Parliament, saved Faraday to us, and thereby, as seems probable, our Institution to the country. The liberality of a Hebrew toy-dealer in the East of London has made the rebuilding of our laboratories possible.

It is said that Mr. Fuller, the feebleness of whose constitution denied him at all other times and places the rest necessary for health, could always find repose and even quiet slumber amid the murmuring lectures of the Royal Institution ; and that, in gratitude for the peaceful hours thus snatched from an otherwise restless life, he bequeathed to us his magnificent legacy of 10,000*l.* If this evening's discourse shall have ensured one such blissful hour to any of his audience, your lecturer's efforts will not have been altogether in vain. But to each such happy individual he would express the hope that, as you have resembled Mr. Fuller in your experience of life, so may you emulate him in your liberality at death. In short, I would conclude almost in the words of old Bishop Andrews: "Unum operæ meæ pretium abs te peto, hoc autem vehementer expeto, ut mei pecatoris meorumque in precibus interdum memor sis." Which being interpreted is: "For these my efforts I beg but one thing in return, and this I beg most earnestly, viz. that you will now and then remember me a sinner against your patience and forbearance in your prayers, and that you will also be mindful of our professorships in your wills."

The following Table of the principal items of original work done by our Professors, taken in connection with their long series of laboratory notes, forms a monument of the intellectual activity, the manual dexterity, and the persevering industry, developed in the laboratories of the Royal Institution:—

DAVY

1806	Chemical Agencies of Electricity.
1807	Decomposition of Potash.
1810	Chlorine.
1812	Discourse on Radiant or Ethereal Matter.
1813	Iodine.
1815–6	Researches on Fire-damp and Flame.
1817	The Safety Lamp.

FARADAY

1820	Alloys of Steel.
1821	History of Electro-magnetism.
„	Magnetic Rotations.
1823	Liquefaction of Chlorine and other Gases.
1825–6	New Compounds of Carbon and Hydrogen.
1825–9	Manufacture of Optical Glass.
1831	Vibrating Surfaces.
„	Magneto-Electricity.
1832	Terrestrial Magneto-Electric Induction
1833	Identity of Electricities.
1834	Electro-Chemical Decomposition.
„	Electricity of the Voltaic Pile.
1835	The Extra Current,
1837–8	Frictional Electricity.
„	Specific Inductive Capacity.
1845–8	Magnetisation of Light.
„	Lines of Magnetic Force.
„	Magnetic Condition of all Matter.
„	Diamagnetism.
„	Magne-Crystallic Action,
1849-50	Magnetism of Flame and Gases.
„	Atmospheric Magnetism.
1856	Relations of Gold and other Metals to Light.
1860	The Regelation of Ice.

TYNDALL

1853	Transmission of Heat through Organic Substances.
1854	Vibrations due to Contact of Bodies at Different Temperatures.
1855	Researches on Diamagnetic Force.
1856	Slaty Cleavage.
1857-8	Physical Properties of Ice and Glaciers.
1859-63	Absorption and Radiation of Heat by Gases.
1865	Calorescence.
1866–7	Action of Heat of high Refrangibility.
1868-9	Formation of Clouds.
„	Colour and Polarisation of the Sky.
1870	Smoke and Dust Respirator.

FRANKLAND

1863-6	Synthesis of Acids of the Lactic Series.
1863	Mercury-methyl, Mercury-ethyl, and Mercury-amyl.
1864	Transformation of Organo-Mercury Compounds into Organo-Zinc Compounds.
„	Combustion of Iron in Compressed Oxygen.
1865	Synthesis of Acids of the Acrylic Series.
„	Synthesis of Fatty Acids.
1866	New Organic Radical Oxatyl.
1866	The Source of Muscular Power. Potential Energy in various kinds of Food.
1867	Source of Light in Flame. Effect of Pressure upon Luminosity of Flame.

THE GROWTH AND MIGRATIONS OF HELMINTHS

THE migration of helminths is one of the most interesting discoveries of modern zoology. These worms, generally parasitic, must often, in order to complete their growth, pass from one animal into another. This passage is of course accomplished by chance, as when one animal devours the whole or part of another, in which the helminth at a certain stage may be imbedded.

It is known that sheep attacked by sturdy, have in their brain a little worm, the *Cœnurus*. That worm when it is eaten by a dog is not digested by him, but grows in the intestine under the form of a peculiar tænia. It is also known that the tænia, or tape-worm, is generated by the growth of the human cysticercus of the pig. Very interesting researches have been made by several physiologists on that subject.

M. Villot has filled up many gaps in the history of the growth of the gordins. The gordins (Müller) are aquatic worms, whose body is very long and slim, the extremities being obtuse.

The form of the embryo is very different from that of the full-grown animal. It is a microscopic worm, cylindrical, not more than 0·209 mm. (0·00807 in.) in length, by 0·049 mm. (0·00177 in.) in breadth, and on which a head and a tail can be easily discerned. The head, as big as the body, is quite retractile; it has a triple crown of prickles, and is terminated in front by a kind of trunk or sucker, which is kept rigid by three strong needles that serve it as support; the head, in its motion of protraction and retraction, turns from its extremity to its base as a glove, and during that time the points of the prickles describe half a circle. When the head is out of the body, the point is directed backward: when it is retracted into the interior of the body the reverse takes place.

Numerous transverse folds exist on the body; they are close to one another and regular as real rings. The tail, not quite so broad as the body, is separated from it by a deep groove.

The great difference between those embryos that are free in the water and the worms which grow out of them after many migrations into the interior of several animals, deserves to be noticed. The embryo after leaving its egg for the water in which it must live, has little means of locomotion. Its tail, cylindrical and scarcely moveable, is useless to it for swimming, so that it may be driven by any current. It probably sticks to pebbles, or to the roots or stems of aquatic plants, where it waits for the larvæ, whose parasite it is to become. The author has verified these statements by putting in the same vessel several embryos with larvæ of tipulars (*Corethra, Janipus, Chironomus*), and has seen the former encyst themselves in the insects. The worm penetrates with its cephalic prickles into those larvæ, the teguments of which have little power of resistance. It continues the operation, piercing through more and more, till the membranes get solidified around it and form a real cyst, shut up at the posterior post. It continues to penetrate the body of the larvæ, lengthening its cyst and proceeds.

Those cysts do not grow normally in the interior of insects as has been believed up to this time, but in certain fishes, and particularly in the loaches (*Cobitis barbatula*) and minnows (*Phoxinus lavis*). Fishes are generally very fond of the larvæ of insects, but most especially for the larvæ of Chironomus. It is precisely in those larvæ, as we have already seen, that the embryos of gordins encyst themselves. By swallowing them, the fish swallows at the same time the cyst which they contain. The insects and their cysts thus arrive in its intestine; the insects are digested by it, the membranes of the cysts are dissolved, and the embryos included in them are set free. The latter settle immediately in their new living abode; by their cephalic prickles they penetrate into the membrane of the intestines and encyst themselves again.

But that new cyst is not like the one that protects the embryo in the body of the insect; it is spherical or ovoid, not lengthened, and provided with a membrane not thick and opaque, but slender and perfectly transparent.

In that second state it undergoes another and important transformation and becomes a larva. The tail, hardly as long as the body, extends more and more, rolling up on itself; the body extends likewise, and the groove situated between them vanishes and the volume of the cyst increases at the same time. The worm, thus merely transformed, resembles a hematoid in its general appearance, though its unmodified head makes what is more like acanthocephalus.

When in autumn one of the above-named fishes is dissected and the intestine is laid over a glass slide, microscopical examination shows that it is strewed with numerous cysts containing embryos and larvæ of gordins at different stages of growth. The author has always found some. Sometimes they almost touch each other, so numerous are they.

The gordins offer, then, in the course of their growth, complete metamorphosis and very complicated migrations; they take successively three distinct forms, encyst themselves twice, and change three times their abode. In the embryo state they at first live in water, then in the body of several aquatic larvæ of Diptera, and in the state of larvæ they inhabit the intestines of fishes; at last, in the perfect condition, they cease to be parasites and become river worms.

There exists, however, an important hiatus in the history of the growth of these worms. How can we harmonise what has just been said with the assertion (that seems to be trustworthy) of the naturalists who have seen real gordins in the abdomen of terrestrial insects (grasshoppers, crickets, &c.)? Has there been an error of observation committed? Or would these be single individuals gone astray from the water where they had to lay their eggs? M. Villot adopts the latter opinion.

Should any one ask of what service are such curious, difficult, and apparently useless researches, it could be replied that many illnesses, some of them mortal, arise from parasites that attack certain parts of our body (the intestines, the liver, &c.); and every advance in our knowledge of the habits of those beings is a service rendered, not only to science, but also to humanity.

M. CORNU

A PRIVATE CIRCUMNAVIGATING EXPEDITION

IN *Les Mondes*, for some time past, details have been given of a proposed expedition, partly scientific and partly for pleasure, on a somewhat gigantic scale. The proposed scheme seems to be the idea of a single gentleman, M. le Capitaine Bazerque, who has been twice round the world; though it has the hearty commendation of the Abbé Moigno, editor of *Les Mondes*, and of Le Comte Pennazzi, as well as others. The scheme is called "La Caravane Universelle," and has for its main object a grand voyage for scientific exploration over the five parts of the globe. The excursion-party may be joined by men of science, and also, we understand, by artists and others belonging to all nationalities, who wish to see the world for themselves under intelligent guidance. A subscription has been opened in the various European countries and in America, to provide Captain Bazerque with a steam-vessel suitable for the expedition. The *modus operandi*, we understand, will be that the vessel shall visit in succession all the most interesting parts of the world, staying long enough at each place to enable all its features to be investigated by the *savants* and artists composing the expedition. "The material organisation of the expedition," says Count Pennazzi in commending it, "will allow those who form part of it to investigate thoroughly the rich treasures of Nature. The eastern slope of the Cordilleras, the sources and upper course of the Amazon, the Rocky Mountains, the country of the Mormons, the eastern coast of Africa, Australia, Japan, China, Indies, are among the regions whose flora, fauna, geology, and ethnography will furnish to the caravan much that is unknown to discover, and many interesting problems to solve." Verily the Count is right in calling the scheme "sympathetique et seduisant."

The organiser of the scheme intends, of course, that the vessel shall be fully furnished with all necessary scientific instruments. As concerns the material and moral well-being of his "sage companions," Captain Bazerque proposes to make the following provisions:—(1) Bi-monthly telegraphic communication between each of the members of the caravan and his family. (2) A Roman Catholic and Protestant chaplain to accompany the expedition. (3) Special and easy camping material, allowing the expedition to sojourn in the midst of countries hitherto unexplored. (4) To ensure the possibility of transit everywhere, a company of sappers will be provided, to go before and clear the way of wood; to construct rafts, bridges, to help as instrument-holders, constructors of beacons and of marks. It is supposed that 35 sailors will fulfil these and many other useful functions.

The Captain proposes to divide the scientific work of the expedition as follows:—(1) Meteorology, astronomy, and terrestrial magnetism; (2) Geography and cosmography; (3) Mineralogy, geology, palæontology, botany, zoology; (4) Anthropology, ethnology, ethnography; (5) Hygiene, medicine and surgery; (6) Photography applied to the works of man; (7) Study and collection of agricultural processes and implements; (8) Study, collection, and photographing of pottery: (9) Metallurgy and metallurgic history; (10) Dye-stuffs; (11) Histology, archæology, biography; (12) "Compte rendu anecdotique de l'expedition." In order to keep the eager world informed of the conquests of this scientific army, the bold originator contemplates the establishment of a periodical, *La Caravane Universelle*, exclusively devoted to the chronicling of its deeds. This journal will be under the care of a central editorial committee, located in Paris, we suppose, to whom will be sent, every month, collections of plants and other objects, photographs, drawings, and statistics of all kinds, together with a scientific and descriptive narrative of what is seen and done. The journal will be printed in handsome type, embellished with engravings, maps, and drawings "by the best European artists;" and each number will appear in English, French, German, Spanish, and Italian.

When we say that *Les Mondes* publishes an elaborate table, showing the states and countries to be visited, the families, tribes, and races of the Aborigines, and the conquering families, our readers will perceive that from beginning to end the scheme is thoroughly French in the ideal perfection and completeness of its conception and plan.

Much, no doubt, can be accomplished by a judicious division of labour; and if the 100 or 150 gentlemen who are expected to compose the expedition should always be of one mind, be all animated by such a love for science as to be willing to endure any hardships, be prepared to submit implicitly to the guidance of a man of perfect organising faculty, wide knowledge and sympathy, combined with promptness and decision; if each confines himself strictly to the department for which his experience and attainments fit him, and if various other important conditions are fulfilled, *La Caravane Universelle* may have something worth listening to, to tell the world monthly. At all events, we heartily wish the project success, and hope that Captain Bazerque may soon have a list of subscriptions large enough to encourage him to commence the practical organisation of his scientific pleasure-party. We see from *Les Mondes* of January 23, that at Captain Bazerque's request, M. de Quatrefages, president of the Academy, has nominated a committee to indicate the principal parts of the earth that ought to be specially explored, and to find out a number of young energetic European men of science, willing to accompany the expedition.

Hitherto such expeditions have been thought practicable only with Government assistance. If Captain Bazerque's scheme is successful in all respects, he will have the merit of showing that Science need not look to Government for help, even in her weightiest undertakings, though we fear the world is not yet ripe for this new application of "the voluntary principle."

FOSSIL CRYPTOGAMS

THE exogenous (circumferential) growth of fossil vascular cryptogams is a subject of so much interest and importance, that I may perhaps be permitted to say a few words regarding it. In a paper which was read at the December meeting of the Edinburgh Botanical Society, I combated the idea of the circumferential growth of calamites. The moist nature of the soil in which calamites must have grown would lead one to expect a poor development of the fibro-vascular bundles, and in comparing what I believe to be the fibro-vascular bundles of calamites with those of our recent equisetums, this idea is fully confirmed. Then in Equisetum there is a large development of the sclerenchyma of Mettenius, which forms the strong hypoderma. In a Brazilian fern which has come under my notice, this sclerenchyma runs to the fibro-vascular bundles, and presents an appearance exactly like Williamson's woody wedges, the large and small cells giving an appearance wonderfully like medullary rays. There is another point which, to my mind, is of much importance; namely, that in most of our recent vascular cryptograms, the embryonic parts do not enlarge; but as each successive leaf and portion of stem is produced, every such leaf and portion of stem is larger than the part preceding it, and this continues until a certain maximum is reached, when the stem becomes cylindrical. It is impossible to overlook that this mode of growth is evident in calamites, and until convincing proof can be brought forward of the circumferential growth of calamites, I must decline to accept it.

Turning from the calamites to Lepidodendron, it is evident that in it circumferential growth was much more likely to have occurred. In the calamites there is no evidence that they required year by year increasing quantities of water for purposes of transpiration, while in Lepidodendron the numerous small leaves which must have gone on increasing in number during the whole life of the plant (which however need not have been very long) demands that some addition to the conducting tissue should be made. As in botany we constantly find the same physiological purpose provided for in many morphologically distinct ways, I do not think it is at all necessary to believe in a form of growth identical with that in dicotyledons, because that would involve a complete change in type. Looking at such a stem as *Lycopodium chamaecyparissus*, in which the cortical tissues become so curiously modified, there is no difficulty in imagining that an increase by means of a cortical meristem might take place, a condition which I believe still exists in Isoetes. Hegelmaier in his paper, "Zur Morphologie der Gattung Lycopodium" in the *Botanische Zeitung*, 1872, p. 796, points out the presence in lycopods of a peculiar layer which he calls the *phloem sheath*, outside the phloem of the bundle, but inside the cortical portion, and therefore a series of cells belonging to the plerom and not to the periblem tissues. It seems to me probable that this phloem sheath may have represented a meristem layer from which new tissue was formed, as it would be the representative of the plerom meristem of the higher plants, while its position outside the vessels would further seem in some way related to the absence of vessels in the secondary wood of conifers.

Passing from the fossil lycopods, of which Lepidodendron is the type, with its central axis of fibro-vascular bundles, we come to Dictyoxylon, which I believe we must take as the type of Strasburger's new group the Lycopteridæ (Die Coniferen und die Gnetaceen, p. 259). Strasburger, in pointing out the relation of the archisperms to the vascular cryptogams, shows that the transition from the lycopods to the conifers is abrupt, and states that a new group intermediate between the two must have existed. To this group he gives the name Lycopteridæ, and I have no hesitation in referring Dictyoxylon stigmaria and sigillaria to it, and considering the former to be the type. The main root of stigmaria has more affinity with conifers than lycopods, while the branching of the root is distinctly lycopodiacous and not coniferous the root of conifers not branching in a dichotomous manner. It is not difficult to understand how the phloem sheath would in Dictyoxylon be still further differentiated, as plerom meristem, and even true cambium formed, thus affording the passage from the lycopodiacious to the archispermous stem. It is also not improbable that trigonocarpon may be referable to the lycopteridæ. While therefore I cannot see my way to accept the theory of the exogenous growth of calamites, I do not see any reason to doubt that in lycopods the circumferential growth may have taken place by means either of a periblem meristem, or plerom meristem, or by both: while in Dictyoxylon the relation of the growth of the stem to that of a conifer must be very close indeed.

W. R. McNAB

NOTES

ONE of the principal events of the past week has been the funeral of Professor Sedgwick, whose death, though at a ripe old age and after a life devoted to work of the highest importance, yielding valuable results to Science, has called forth expressions of sympathy and regret from all quarters, from Royalty downwards. In this week's NATURE will be found a sketch of the life and work of the veteran geologist, from the pen of one who knew him long and well.

COALS in London are up to 48*s*. a ton, and there seems every probability that the rising process will continue. If they went at once up to 100*s*. a ton it might be the best thing that could happen to the nation, as thereby it might be "tunded" into adopting one or more of the obvious and easily applied means whereby the scandalous waste of our precious fuel might be avoided. It is a low average when we say that at least three-fourths of our coal is absolutely thrown away, and that simply because people "canna be fash'd" to prevent it. Men of science have dinned the alarming state of "the coal-question" into the ears of the nation for years, but we fear most men's heads, like their hearts, must be reached through their pockets. Sir W. Armstrong's address at Newcastle, which we reprint this week, is one of the most practical, forcible, and intelligent on the subject we have hitherto seen. It is deserving of attention from all who have to pay for coals.

THE Council of the Anthropological Institute has appointed a Committee of Psychological Research, viz., Francis Galton, F.R.S., chairman; Dr. John Beddoe; Hyde Clarke; David Forbes, F.R.S.; Sir John Lubbock, Bt., F.R.S.; E. B. Tylor, F.R.S.; A. R. Wallace; with power to add to their number, and to confer with other scientific bodies.

THE United States exploring ship *Portsmouth*, which has been busily engaged in preparing for her cruise to the Pacific, has finally left for her destination. The scientific corps of the expedition is to consist of Messrs. Byer and Beardsley, from the Hydrographic Office, Washington, Paymaster Horace P. Tuttle as astronomer, and Dr. Streets as naturalist. The *Portsmouth* will carry three steam launches for cruising around shoal places.

THE Tyneside Naturalists Field Club have struck out a new line of work for similar societies throughout the country. They propose to obtain a complete record of all remarkable trees at present growing in the district embraced by the club, whether from their age, dimensions, or historic associations. Seventy or eighty such trees have already been catalogued from information supplied by the members of the club; and it is proposed that the record shall be as full and complete as possible, both in respect to letterpress and illustrations. The letterpress is to consist of the fullest particulars obtainable as to measurements and history, and it is recommended by the Committee appointed on the subject that the illustrations be photographs taken by some permanent process, either Swan's "carbon" or the "Woodbury;" the expenses to be paid out of the general funds of the Club, the catalogue to be supplied to members of the Club for a small subscription, to the general public at a higher rate. It is obvious that such an illustrated catalogue will become very useful in after years, especially if the observations are repeated on the same trees at intervals. Though the Woolhope Club has already published in its Reports photographs of a few remarkable trees, we do not recollect that anything of this kind has been hitherto attempted in a systematic way.

THE Academy of Natural Sciences at Stockholm has recently purchased one of the finest cryptogamic herbaria in existence, the great collection of European mosses formed by Milde.

THE Royal Commission of Scientific Instruction and the Advancement of Science holds its first meeting of this session to day.

THERE are at present five candidates for the vacant Professorship of Geology at Cambridge—the Rev. T. G. Bonney, M.A., Fellow of St. John's College; Mr. W. Boyd Dawkins, M.A., F.R.S., of Jesus College, Oxford, and Director of the Owens College Museum, Manchester; the Rev. Osmond Fisher, M.A., late Fellow and Tutor of Jesus College; Mr. McK. Hughes, Member of the Geological Survey; and Mr. A. H Green, M.A., late Fellow of Caius College.

A CORRESPONDENT writes, with regard to hurricanes in the Mauritius (vol. vii. p. 250), that it is desirable applications should be made to the French Minister of Marine, as it is possible log-books of men-of-war may be preserved, which will fill up the lacunæ in the last century. In the beginning of this century our Admiralty records may supply additional information.

DR. E. L. MOSS, of the Royal Naval Hospital, Esquimalt, Vancouver's Island, writes us that on the night of Saturday, Dec. 14, an earthquake wave passed through the district at 9.33. A rumbling noise and a quick vibration, causing the windows to rattle, preceded the shock a few seconds. The waves then passed from E.N.E. to W.S.W., causing the wooden house in which he sat to creak and strain like a ship at sea, and leaving an index of their direction in the oscillations of a swinging lamp. He could not detect any accompanying marine wave. The ship's lights were reflected from the surface of the harbour in perfectly unbroken lines. The night was clear, the thermometer at 27°, and there was no trace of aurora. From the *Daily British Colonist* we learn that the shock appears to have been more severely felt on the mainland than on the island. At Olympia and Seattle the shock was very severe, and was accompanied by a slight tidal wave. At Clinton the ground was cracked, and the shock was felt at all the towns on the Fraser. Since 1864 Victoria has not experienced so severe a shock of earthquake.

DR. DUDLEY, of Bogotá, South America, writes that on the morning of Dec. 17 last, at $4^h\ 20^m$ A.M., a smart shock of earthquake was felt at that place, which lasted about 20 seconds. It appeared to move in a S.W. direction. It was sufficiently strong to awaken the inhabitants from their sleep with some alarm.

THE *Times of India* reports a very destructive earthquake which occurred in Sinde on the evening of December 15 last. A succession of shocks took place about 9 o'clock at Shekarpore and other places, followed by a slight shock at about half-past 10. In the town of Lehree, in Eastern Catchi and Zehri, according to one report 200, according to another 500 persons were killed from the fall of houses and walls. The direction of the earthquake was from east to west, with a slightly undulating motion.

ACCORDING to a telegram in the *Times* from Constantinople, February 4, the island of Samos had been visited with successive shocks of earthquake during the previous four days, gradually increasing in violence. Houses have been destroyed, and the affrighted inhabitants of the island are wandering about the open country.

A CORRESPONDENT sends us the following:—"A correspondent in Salvador, in Central America, under date of December 8, writes to the *Panama Record* as follows:—'The volcano which is some six leagues distant from the town of Santana, has dried up a lake which for 500 years or so existed at the base of the craters; but although vast quantities of steam are ejected, and the trees lining the inside of the crater are scorched up and withered, as also are those to a limited distance near the top on the outside, no ejection of lava has yet taken place. The volcano of Isaleo, which was active until quite recently, now shows no sign of life; and the supposition is that some strata which cut off the communication between the two volcanoes have burst through or fallen in, and so changed the channel of the fire. The Government of Salvador intends sending up an exploring party to examine and report on the subject. At the date of the above letter, no change had taken place in the volcano.

MR. HARDING, senior wrangler at Cambridge, has been declared first Smith's prizeman; while the second prize has gone to Mr. Nanson, the second wrangler.

WE have received a paper by Prof. Theodor von Oppolzer on the comet discovered by Pogson on December 2, following the telegraphic hint of Prof. Klinkerfues. Prof. Oppolzer enters into an elaborate series of calculations to prove that the observed comet was intimately connected with the star-shower of November 27, and that in all probability it was one of the heads of Biela's comet.

A REPORT, coming of course from America, has been going the round of the papers that Prof. Tyndall has been coining money by thousands from his lectures in the United States. Dr. Bence Jones writes to *Les Mondes* of January 30, giving the facts of the case, as told by Prof. Tyndall himself. His expenses in America, partly caused by the death of "poor Millard," his assistant, have been very high. There still remains, however, Prof. Tyndall says, 2,000*l*. This sum he intends to devote, in consultation with Prof. Henry of Washington, to the promotion of some worthy purpose in America.

WE are glad to see that a new edition of Chambers's *Information for the People* is about to be issued. The first edition was issued in 1833, and the last in 1857, since which, science in all its departments has made such rapid strides that scientific treatises published sixteen years ago must now be considered seriously defective and in many cases absolutely misleading. We are therefore glad to see from the prospectus that the scientific treatises have been entirely recast, so as to be adapted as nearly as possible to the present state of knowledge, and we have reason to believe that the various articles have been put into the hands of men who are acknowledged masters of their several subjects. Indeed we think it a sufficient guarantee that the work will in every respect be up to the mark, that the editorial supervision has been entrusted to Dr. Andrew Findlater, who has already deservedly won himself so great credit as Editor of Chambers's *Encyclopædia*; science at least is likely to have fair play in his hands. This work has already done much good in spreading accurate and valuable knowledge among the people. We hope the new edition will have as wide a circulation as its predecessors among the classes for whom it is adapted.

A SUPPLEMENTARY number of *L'Institut* has been issued, containing reports of the French Academy from September 5 to December 26, 1870, during which time, on account of the investment of Paris, the publication of the journal had to be suspended. Besides the French Academy, it contains reports of the Royal Society, the Berlin, Munich, and St. Petersburg Academies of Science, and the Göttingen Society of Science for the same period.

WE have received the "Report of the Birmingham School Natural History Society" for the year 1872, and a very satisfactory one it is. The society was founded in 1869, under the auspices of the Rev. C. Evans, Head Master of the school, since which it has made very creditable progress. Liberal grants have been made by the governors of the school for the purchase of books on Natural History, and the library contains several standard works. In 1871 a museum was fitted up, and during the past year three sections have been formed—botanical, entomological, and geological; and it is hoped that, eventually, new sections will be formed for the study of other subjects, such as physiology, zoology, &c. Three excursions have been made during the year, and there would have been several more, had it not been for unfavourable weather. The report contains some very creditable papers by the youthful members of the society, and we hope that future reports will contain the results of original observations on the part of the members.

FROM the report of the Grant Medical College, Bombay, we learn that during 1872 the total number of students was 283, showing an increase of 37 over 1871. Great improvements have taken place in the Museum, and Dr. Sylvester, the officiating principal, says, that for the last twenty years it has not been in such good order as it is at present. Dr. Sylvester reports that the system of education is not so sound and deep as it ought to be, and wisely reccommends that some subjects should be omitted from the course, and a more strict and penetrating knowledge insisted on in the others. He also seems to think that more care ought to be exercised in the appointment of professors, and that a sort of supplementary professor should be appointed to each chair, who would be ready at any time to undertake the duties of the professorship in case of a vacancy.

WE are glad to notice that the evening lectures to working men at the school of Mines have been eminently successful. The 600 available seats are all occupied, and about 600 more applicants have been necessarily refused. Those who attend are all *bona fide* working men, who in various ways show that they appreciate and understand the scientific lectures delivered. Each professor gives a course of six lectures every other year.

EARLY on Saturday morning a fire broke out in the Royal Military Academy at Woolwich, which terminated in the total destruction of the large central block of the building. A foul flue is supposed to have been the cause of the fire. The damage is estimated at 100,000*l.*

THE principal paper in *La Revue Scientifique* for February 1 is a long analysis of Darwin's Descent of Man, which has recently been translated into French. The writer endeavours to give a perfectly fair view of the work, but the tone of the article shows that Darwin is beginning to be better understood and appreciated in France than he has hitherto been. The writer sees in Darwinism a gigantic effort of the human mind to arrive at an explanation of phenomena which had previously been regarded as beyond the human grasp. He thinks it the duty of every naturalist, whatever may be his leanings, to study the facts and theories put forth by Darwin.

WE have received the prospectus of a German work likely to be of considerable interest and value—a history of Writing ("Geschichte der Schrift und Schrifttums," &c.) and written characters, symbolical and otherwise, from its earliest beginning in the shape of tattoo marks, down to the signs used in modern telegraphy, including an account of the modes of writing among all the nations of the world, savage and civilised. The specimens of the illustrations sent us are carefully executed; one of them represents a man, most elaborately and minutely tattooed from the crown of his head to the tips of his toes. The author is Heinrich Wuttke.

WE noted some time since that the French Government contemplated suppressing the *Bureau des Longitudes*, in order to save its expense to the nation. The French Academy has made a vigorous and indignant protest against such a philistian proposal. The protest recounts the glories which have in former times accrued to France from the discoveries of its eminent astronomers, shows the important position formerly held by the *Bureau*, the valuable assistance it has given to astronomy and navigation by means of its journal, the *Connaissance des Temps*, and declares that by degrees in recent years, the means of doing efficient work have been withdrawn from it. Since 1854 the *Bureau* has ceased to have the control of the Observatory. The Academy demands that instead of suppressing the institution, Government should restore to it the means of making itself more useful.

THE first number of an illustrated paper printed in Japanese, *Tai Sei Shimbun*, or *Great Western News*, was published in London on January 15. Its object is to clearly reflect the opinions of Japanese who have seen the world and learned European languages for the benefit of their countrymen at home. It is edited by a Japanese resident in London, in conjunction with Prof Summers, of King's College.

A CORRESPONDENT writes asking us whether any Alpine walker among our readers has had experience of Sir T. Troubridge's knapsack, the weight of which is borne principally upon the pelvis instead of on the shoulders, thus leaving the chest more free. Also where it can be obtained.

WITH the commencement of volume lxxxi. of *Astronomische Nachrichten*, the office of that journal will be removed from Altona to the Observatory at Kiel, to Prof. C. A. F. Peters, at which address all communications should be sent.

No. 1917 of *Astronomische Nachrichten* is mainly occupied with letters from various quarters on the star-shower of Nov. 27, 1872.

To No. 1919 of *Astronomische Nachrichten*, Prof. Spörer contributes the results of observations on the distribution of sun-spots for the periods of rotation, vi. and vii., for the year 1871.

SIR BARTLE FRERE and suite arrived at Zanzibar Jan 12.

NORTH Africa is at present overrun by exploring expeditions. The latest news from Sir Samuel Baker is contained in a telegram dated Khartoum, Nov. 7, 1872. According to this he left Gondokoro in 1871 for Kimrasi, but from the hostility of the natives was compelled to return some distance. In consequence of the prolonged absence of Sir Samuel, we learn from *Ocean Highways*, the Viceroy of Egypt decided upon sending a relief expedition of sixty-five men under the command of Colonel Purdy, an American officer in the Egyptian service. The plan is to start from Mombas and to make a journey to the supposed position of Baker, above Gondokoro. If the expedition is successful, very important geographical results may be expected from the route to be taken by Colonel Purdy, which will lead him across the Victoria Nyanza region.

Ocean Highways for February contains the first part of an article by Dr. Beke, entitled, "Position of the Sources of the Nile," his object being to show the influence which Ptolemy's determination of these sources has had on later geographers, down even to Livingstone, who adheres essentially to Ptolemy's opinion. The almost unanimous conclusion, however, come to by geographers of the present day, Dr. Beke tells us, is that the rivers described by Livingstone are tributaries of the Congo, and that the numerous sources described by him as the great water-parting of Southern Africa, are those of that river, and not of the Nile.

COMANDATORE NEGRI is making satisfactory progress in his endeavour to enlist Italian public opinion in favour of an Italian Arctic expedition.

THE first number of *Kosmos*, an Italian geographical bimonthly journal, edited by Guido Cora, has just appeared.

IN NATURE for Jan. 23, we noted the supposed discovery of a great Arctic Continent by M. Pavy. The story appeared many weeks ago in the *Scotsman*, which took it from "the American papers." We, however, took no "note" of it till a similar account appeared in the *Times* a week or two ago, when we noted it with some expressed distrust. According to *Ocean Highways*, the story, as we feared, turns out to be, in all likelihood, a hoax. The French Geographical Society have received no such report as the American papers say has been transmitted to them. Far from M. Pavy having reached Wrangell Land, there are now doubts whether the expedition will start at all.

WE learn from the *Athenæum* that Sir John Lubbock is preparing a Bill, to be brought forward early this session, having for its object the preservation of the megalithic monuments to the United Kingdom.

WE have received the first number of the *Journal of the Women's Educational Union*, the main purpose of which is to promote the very commendable objects of that Union.

FROM pamphlets and periodicals before us we cull the following notes:—Dr. Hollis's *Astronomical Almanack* for 1873 contains a large quantity of very valuable and well-arranged information, which will be found useful to the rapidly increasing number of amateur astronomers, and to those who do not possess or who shrink from consulting the "Nautical Almanack."—The *Garden* learns that the celebrated Jardin Fleuriste of the city of Paris, which since the war has been in a ruinous condition, is at last to be entirely abolished, and the ground whereon it stood let for building purposes. A few years ago it was one of the most interesting and instructive gardens in existence.—The principal articles in the *Journal de Physique* for January are a review of the fundamental theories relative to electrodynamics and induction, by M. A. Potter: one by M. Berthelot on Calorimetric thermometers, in which he expounds the results of his studies on the subject for a number of years past: and a short one by M. C. Decharme, giving the results of a number of experiments to show the rate at which different liquids ascend a capillary tube.—A French newspaper, the *Monde*, contains a justly laudatory article on the Abbé Moigno's *Salles du Progrès*, which it seems are being more and more taken advantage of by the Parisian middle classes.—The "Annuaire de l'Academie Royale de Belgique," besides a mass of valuable information concerning the Academy, contains memoirs of a number of deceased Academicians, including one of the late Mr. Babbage, who was an associate of the Academy.—The *Penn Monthly* (Philadelphia) for May, July, August, and September, contains a series of articles by Mr. Edward D. Cope, on "Evolution and its consequences," in which is expounded the theory of evolution so far as it concerns animals and plants.—We have received a reprint from the *Quarterly Journal of the Geological Society* of the admirable paper "On the Evidence for the Ice-sheet in North Lancashire and adjacent parts of Yorkshire and Westmoreland," by Mr. R. H. Tiddeman, M.A., F.G.S., of the Geological Survey. It is accompanied by a well constructed map.—An address delivered before the Chemical Society of the Lehigh University, by Dr. B. Silliman, on "Deductive and Inductive Training," contains a very interesting history of the two systems from the earliest times to the present day.—A translation of Prof. Donati's oration at the inauguration of the new observatory at Florence, October 27, 1872, appears in the *Astronomical Register* for February.

ON THE COAL QUESTION[*]

THE North of England Institute of Mining and Mechanical Engineers was, in its origin, a society limited in its scope to the discussion of subjects belonging to the practice of mining, and especially of coal mining. At that period the working of coal and other minerals was carried on with less aid from machinery than at present, and the district in which the society is located was not so distinguished as it now is for the practice of mechanical engineering in all its branches. Hence, the society, in its growth, has gradually assumed more and more of an engineering character; and my recent election, as your president, indicates that mechanical science is no longer regarded by the members as secondary, or merely subsidiary, to the practice of mining. But we must guard against this tendency of the engineering element to outgrow the mining element of this institute. We must not forget that we are situated in the very heart of the coalfield which, more than any other, has rendered England pre-eminent as a producing nation, and that, notwithstanding the increasing magnitude and importance of the engineering works of this district, the raising of coal is still foremost amongst the industries of the North, both as regards the extent of the interests involved, and its importance to the general prosperity of the nation.

For these reasons, although I come before you as the first president of this society elected from the ranks of mechanical engineers, I shall, in this address, make coal the principal topic of my remarks, including, however, mechanical applications associated with its use or involved in its production. As I shall speak of coal in an economic as well as in a technical point of view, I cannot well avoid making some reference to its present excessive cost, because coal, like everything else, must be governed in the extent of its application by its price in the market. In addressing an institution, so largely composed as this is of colliery proprietors, it is not an agreeable task to dwell on the evil of dear coal; but our institution is not a commercial one, and I must speak of this subject, not as affecting individual interests, but as bearing upon mechanical art and national prosperity. For many years past the consumption of coal has been increasing at the rate of about 4 per cent. per annum, computed in the manner of compound interest. We are all familiar with the cumulative effects of compound rates of increase; and it is easy to see that if the consumption of coal continued to advance at this rate, we should speedily arrive at impossible quantities. Thus in 18 years our present enormous consumption would be doubled; in 36 years it would be quadrupled; and in 54 years it would be eight times greater than at present. It is clear, therefore, that our consumption has been increasing at a rate which could not possibly last. If nothing else was destined to arrest it, a failure of mining labour was inevitably approaching to have that effect; but a few years would probably have yet elapsed before the number of hands became inadequate to meet the required demand, had not the miners precipitated the event by restricting the hours of work. The hours of mining labour in this district 25 years ago were 9 per day. At a subsequent date they were reduced to 8, then to 7, and finally to 6. Hitherto, the men have worked 11 days a fortnight, but it seems doubtful whether more than 10 can now be worked consistently with the very proper limitations of the recent Coal Mines' Act, in regard to the labour of the boys. The full hours per fortnight will, therefore, at the most, be 66, or 33 hours per week of labour at the face of the coal; but as it is only the steadiest men that work full time, the average time will, of course, be considerably below that limit.

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[*] Inaugural Address by Sir William Armstrong, C.B., President of the North of England Institute of Mining and Mechanical Engineers, delivered at Newcastle, February 1.

I am not aware to what extent reduction of time has been carried in other parts of England; but we hear of the same policy of restriction, either of time or output, or of both, being put in practice in all the important coal districts. I do not suppose that the average output, per man, has fallen off proportionately to the reduction of hours. The men work hard, even harder than formerly, while at their post, but it is impossible that so great a reduction of working time can have taken place without so lessening the output, per head, as to neutralise in a great degree the increase of production due to the numerical growth of the mining population. Under these two conditions of increasing consumption and restricted labour, we have reached a point at which the demand has overtaken the supply. As yet, the deficiency cannot be great, for it has only very recently become apparent. Consumption does not advance by jumps; and we may assume that if a progressive increase of four or five per cent. per annum could have been maintained in the production of coal, a balance would still have existed between supply and demand. Though production has ceased to keep up with demand, it has not, so far as we can judge, actually receded, and it would therefore appear that a small addition to the present supply would restore the equilibrium. But small as the deficiency must be, it is sufficient to create a sense of scarcity, and as a consequence, to send up coals to a famine pitch.

The situation is a grave one, and the public has not yet fully realised how very grave it is. Taking the present consumption at 110 millions of tons (evclusive of exportation) and estimating the extra price to consumers at 8*s*. a ton over all, the annual loss to the community from the additional cost of fuel, amounts to 44 millions sterling. Had a Government tax of 44 millions been levied upon coal, in addition to existing taxation, the effect would have been regarded as utterly ruinous, not only in regard to its prodigious amount, but on account of its repressive effect upon every kind of production. Yet it is a fact that we are now paying the equivalent of such a tax, with this unfavourable difference, that the money does not go into the coffers of the nation. Whether it chiefly goes to coal-owners or coal-miners is a question which I need not discuss, but I may observe that the restrictive action of the men has benefitted their employers as well as themselves, and that the public are the only sufferers. Coal-owners have long been aware that limitation of quantity was the only effectual mode of raising price, but they have never been able, by their own action, to maintain a restricted production. At last their workmen have done it for them, and we see the result.

Whether the trade of the country will bear up against the heavy burden of dear coal, combined as it is with dearness of other products, arising from similar causes in other industries, is a question on which I shall not attempt to prophesy. It will be more to the purpose to consider what can be done to mitigate the evils under which the nation is now labouring in regard to the price of coal. It is vain to appeal for relief either to coal-owners or coal-workers. Self-interest is the ruling principle of trade, and it is visionary to expect that men will sell either labour or the produce of labour for less than the market price. However generous a man may be, he will not exhibit his generosity by selling an article below its value. Speaking then, as one of the public and not as a coal-owner, I say, we must strive to economise the use of coal; speaking as president of an institution of mining and mechanical engineers, I say, we must endeavour to make up for the deficiency of human labour by a more extended use of machine labour. The waste of coal, both in domestic and manufacturing use is a threadbare subject, but there never was a time when its consideration was of so much importance as at present. The small deficiency of supply which is now so violently stimulating the market would be just as effectually expunged by economising consumption as by increasing production. If, on the one hand, the mining population could easily, by a few hours' addition to their weekly labour, restore the equilibrium between supply and demand, so on the other hand consumers taken as a body, could do the same thing, by discontinuing in a small degree those reckless habits of wasting coal to which they obstinately adhere.

The consumption of coal takes place under three great divisions, each absorbing about one-third of the whole produce:—(1) domestic consumption; (2) steam-engine consumption; and (3) iron making and other manufacturing processes. In the first two divisions the waste is simply shameful; in the third it is not so great, but still considerable, though in some processes, and especially in the smelting of iron, economy of fuel has been so diligently pursued that there remains but little apparent scope for further saving. I shall not dwell on the waste of coal in domestic consumption, as it is scarcely a subject for engineers; but the circumstances of the times are such as to forbid my passing it unnoticed. It is impossible to conceive any system of heating a dwelling more wasteful than that of sinking the fire-place into a wall directly beneath the chimney which carries off the products of combustion. Nothing can be clearer than the advantage to be gained by merely advancing the fire-place a little into the room, and constructing it with proper heating surfaces, as in the "Gill-stove," and many other stoves acting on the same principle. There is no occasion to shut out the fire from view. Neither is there any difficulty about ventilation, since fresh air can easily be introduced from the exterior by a pipe delivering its supply against the heated plates, so as to temper the air before it enters the room. By this simple and unobjectionable departure from the conventional fire-place, the quantity of coal required to produce a given heating effect might easily be reduced to one-half, and still greater economy would be effected by the use of hot-water apparatus, which, however, has the objection of being too costly in first outlay to admit of very general application. For cooking purposes also, the consumption of coal is in most houses equally extravagant, and I may add, equally inexcusable, since the means of prevention are attainable by the adoption of known methods and appliances for concentrating the heat upon the work to be done.

A more appropriate subject for the consideration of this institution is the wasteful employment of coal for steam power. The steam engine is, at best, a very imperfect machine for utilising the mechanical power of heat, for in no case do we realise more than about one-tenth of the theoretical effect of the fuel. But the difference in economy between our best steam engines and our worst is enormous, and unfortunately by far the most numerous class belong to the category of the worst. In the best kind of engines, the consumption of coal per horse-power is rather less than 2 lbs., but there are thousands of steam engines in daily use which burn from 12 to 14 lbs. per horse-power. This excessive wastefulness arises from defects, both in the mode of raising the steam and in the mode of applying it. Theoretically, 1 lb. of coal is capable of evaporating 13 lbs. of water, but the conclusion arrived at on this subject by the late Royal Commission on the duration of coal was, that in practice 1 lb. of ordinary coal did not, on an average, evaporate more than 4 lbs. of water. The causes of this deficient result are perfectly understood, and, therefore, cannot be excused by ignorance. They are—insufficient boiler surface to absorb the heat, insufficient steam space to allow of a complete separation of the steam from the water, unclothed boilers, and imperfect combustion of the fuel, arising from badly constructed furnaces and from bad firing. The defects in the mode of applying the steam, or in other words, the defects which belong to the engine, in contradistinction to the boiler, are equally well known and equally remediable. The steam—to begin with—should be taken from the boiler at a much higher pressure than is usual. It should be admitted upon the piston at the full boiler pressure, and allowed to expand in the cylinder until its power is practically exhausted. The cut-off valves should be close to the end of the cylinders, as in the Corliss arrangement, so as to leave the smallest possible amount of space between the valve and the piston when commencing its stroke. Finally, the cylinder should be steam jacketed to prevent its cooling during the expansion of the steam, and thereby causing condensation on the next admission of steam. Nobody disputes these requirements of a good engine, and yet how few engines there are in which these conditions are fulfilled. The responsibility, however, for this waste of coal lies more with the users than with the makers of steam engines. Old-fashioned engines are retained in use partly on account of the outlay involved in replacing them, and partly from a dread of novelties and refinements requiring more care and delicacy of treatment than steam engines commonly receive. Even in replacing old engines the repugnance to any increase of first cost, and the distrust of departure from long-tried patterns, powerfully tend to a conservation of antiquated types of steam engines. As an encouragement to those who contemplate reforming their engine power, I may state what my own experience has been of the advantage of so doing. The engines and boilers originally applied at the Elswick Works, though representing a fair average of efficiency, were of the simple description then almost invariably used in factories. My firm, like others, was naturally averse to changing them on account of the expense of so doing; but about two years ago they determined to begin the renovation of all their old engines by putting down, as a first instalment, two large engines of the Corliss pattern to do the work previously performed by ten smaller engines. These two Corliss engines are now both at work. They have boilers of the best construction, and are fitted with various accompaniments favourable to economy of fuel, including Jukes' arrangement of mechanical firing. One of these engines uses twenty-four tons of coal per week against sixty tons used by the engines it has superseded. The other appears to be doing equally well, but I have not the necessary data for making a similar comparison. Assuming the economy effected to be the same in both cases, the aggregate saving of coal amounts to seventy-two tons per week. The number of firemen required is also much diminished, and the general result is, that, notwithstanding the enormous rise which has taken place in the price of coal, the required steam power is now obtained at a less cost than before, after allowing for interest on the capital expended.

Thus, then, the consumers of coal, as well for domestic use as for steam engines (under which two heads about two-thirds of our own consumption are comprised), have it in their power to economise their use of coal to an enormous extent, without any diminution of effect. In metallurgical and other manufacturing processes there is also room for much saving of coal; but I must not extend my observations into that division of the subject. Speaking generally of coal consumption in all its branches, there can be little doubt that without carrying economy to its extreme limits, all the effects we now realise from coal could be attained with half the quantity we use. If a reduction to that, or any approximate extent were effected, we should hear nothing more of scarcity or prohibitive prices for many years to come.

And now as to the practicability of economising human labour in coal mines by the employment of machinery. Much has already been done in applying machinery for the underground traction of coal, and a great reduction has thereby been effected both in men and horses; but the cutting of the coal is still almost exclusively performed by human labour. The service is a hard and dangerous one, and as it requires skill and experience, it is not easily taken up by untrained men. In every point of view, therefore, there is the strongest inducement to substitute mechanical appliances for manual labour in the process of cutting coal. Many attempts have been made to make a machine do the work of a man in this kind of labour, but with only imperfect success; and yet the problem does not appear, upon the face of it, to be one of very difficult solution to persons accustomed to mechanical invention, and thoroughly acquainted with the conditions under which the work has to be performed.

What is wanted, is a machine capable of cutting a groove at the base of the coal, so as to allow the superincumbent mass to be easily dislodged. The mode of cutting may be by hewing, by slotting, by sawing, or by scooping. The machine must travel along the face of the coal so as to follow up its cut. It should have a long face to work at, so as to avoid frequent stops and changes, and for this purpose the long-wall system of working must be adopted. The difficulty of supporting the roof may, in some cases, be an impediment to the adoption of the long-wall system, but I believe the cases would be few in which this difficulty would be insuperable.

Then, as to the power for driving the machine: that must clearly be compressed air transmitted from a steam-engine at the surface, as is now actually practised for the propulsion of all forms of these machines. Compressed air is not an economical medium for transmission of power, partly because the power expended in its preliminary condensation is not recovered by corresponding expansion in the exercise of its power, and partly because much of the force exerted in compression takes the form of heat, which is dissipated during the transmission of the air. In other respects compressed air is peculiarly adapted for conveying power into a mine, because, unlike water, it requires no provision for its removal, and actually helps to supply the necessary ventilation. This is a fair statement of the nature of the work to be done, and of the conditions under which it must be performed. Whatever difficulties there may be must be of a nature capable of being surmounted by mechanical skill and careful observation of the impediments to be overcome. Partial success has already been realised, and I confidently look forward to a time when, to the many services which we exact from coal as a source of motive power, we shall add the cutting of the parent material from the solid beds in which it is deposited.

But it is not alone in coal-mines that the extension of machinery is called for. The dearth of labour is being felt in every department of industry, and we have to fear on the one hand a ruinous collapse of trade, or on the other a continued rise in the price of all productions, threatening to neutralise the advantage of high wages, and impoverish persons dependent on fixed incomes. The only hope that I see of escaping one or other of these alternatives is by increasing the use of machinery and diminishing the direct employment of men. It is in the interest of working men, as well as of all other classes, that we should throw the burden of our wants as much as possible upon inanimate power; and it is a high function of mechanical science to relieve man from that description of labour which consists in the exertion of mere animal force, and leaves him more free for the exercise of skill which is beyond the province of machinery.

One of the worst effects of dear coal is that it involves dear iron. Coal may be economised, but iron cannot, without positive loss. Production of every kind, as also steam navigation and railway transport, are essentially dependent upon the use of iron as well as of coal. Hence, dear iron, like dear coal, is a burden, both on manufacture and on commerce, and its dearness diffuses itself over every article which we derive either from foreign trade, or from home manufacture. But although the present high price of iron is chiefly due to the scarcity of coal, it is not wholly so. The dearness of labour employed in its production is also telling seriously upon its cost, and the importance of substituting some system of mechanical puddling for the present laborious process is daily becoming more apparent. Many inventions for attaining this object have been tried, but no substantial success was realised, until Mr. Danks produced his rotating furnace in America. If Mr. Danks' success be confirmed by continued trials, he will have conferred an immense benefit, both upon the makers and the consumers of iron. Unhappily for him, the general ideas embraced in his apparatus appear to have been suggested before, and although he has the great merit of having shown how the previous ideas on the subject can be rendered available, the patent laws do not afford him that protection which they so lavishly bestow upon others who have accomplished no practical result. Under an equitable and discriminative system of patents, Mr. Danks would have obtained a monopoly as due to the importance of his invention, notwithstanding the abortive attempts of others to reduce the same ideas to successful practice. It is to be hoped that advantage will not be taken of Mr. Danks' unprotected position to deprive him of an adequate reward.

Having spoke of steam engines in reference to the great defects of those in most general use, it is only fair that I should acknowledge the great improvements which are exhibited by nearly all classes of those engines in their most modern forms. Mr. Bramwell, in his recent presidential address to the Mechanical Section of the British Association at Brighton, points out with justice how much has recently been done to improve the efficiency of marine, locomotive, and agricultural engines, and urges the importance of carrying out to a still greater extent the application of those principles which have already been productive of so much advantage. To this recommendation I may add that we must not neglect to follow up any new line of improvement which the progress of discovery may present to us.

(*To be continued.*)

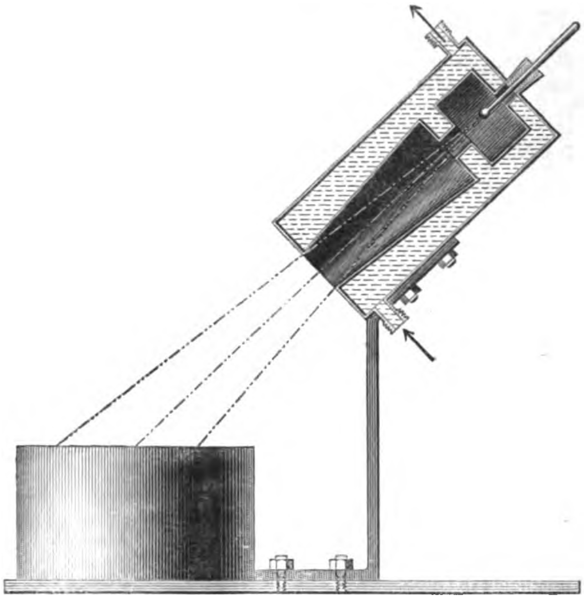
RADIANT HEAT

LORD ROSSE has shown* that the diathermacy of flame cannot be determined by the method described by Mr. W. Mattieu Williams, in his communication to NATURE, vol. vi. p. 506. Referring to the discrepancy which the reader may remember that Mr. Williams pointed out, Lord Rosse says: "The explanation of the discrepancy seems to be that the radiant heat from a flame, like that from any other body, varies as the inverse square of the distance and therefore the total effect is proportional to $\frac{1}{d^2} + \frac{1}{d'^2} + \frac{1}{d''^2}$ + &c., not $\frac{1}{d} + \frac{1}{d'} + \frac{1}{d''}$ + &c., where d, d'', &c., are the distances of the flames from the thermometer; in which latter case the order of lighting the jets would answer the desired object."

Mr. Williams, in order to meet the objection raised, presents calculations based on the assumption that the mean distance between the seventeen small flames and the thermometer is 14 in. The space from centre to centre of the flames being ¼ in., the distance between the thermometer and the centre of the nearest flame will be 12 in. Evidently Mr. Williams is not aware that a thermometer placed at a distance of 12 in. from his cluster of diminutive flames, cannot indicate 53° C. (127·4° F.), unless the surrounding atmosphere be heated to a temperature exceeding 123° F. Had he ascertained, experimentally, that the radiation of a cluster of such feeble flames, at the distance of 12 in. from the thermometer, imparts a temperature less than 3° C. above that of the atmosphere, he would no doubt have admitted the correctness of Lord Rosse's explanation of the supposed discrepancy, as freely as he admits the correctness of the theory on which that explanation is based.

The subject having attracted much attention, the writer has deemed it necessary to institute a series of experiments in order to test the accuracy of the table of temperatures which Mr. Williams desires Lord Rosse to accept on the ground that "the maximum error is less than $\frac{1}{10}$ of a degree, and the mean error lies between that and $\frac{1}{78\cdot33}$ of a degree."

Before entering on an examination of the result of the experiments adverted to, it will be necessary to call attention to the fact that, the transverse sectional area of a flame produced by 17 jets arranged in a straight line, ¼ in. apart, consuming 5 cubic feet of gas an hour, corresponds with the area of a circle of 0·87 in. diameter. The distance between the nearest point of the flame and the thermometer being 12 in., it will be found on calculation that the mean angle subtended by the heat rays projected towards the thermometer will be 4° 9′. Agreeably to the laws of radiation, the temperature produced at a given point by the heat rays projected from a deep radiating body, depends on the mean angle subtended. It may be shown, therefore, that in order to produce the differential temperature of 53° — 19° = 34° C. (61·2° F.), observed by Mr. Williams, the intensity of the flame must far exceed that capable of being developed by any chemical means. A brief explanation of this important subject will be proper in this place. The accompanying illustration represents a pyrometer constructed by the writer for measuring with desirable precision intensities of all degrees. The pyrometer consists of a conical vessel communicating with a cylindrical chamber, as shown in the sectional elevation, both being surrounded by an external vessel through which a current of water, of uniform temperature, is circulated. The thermometer for registering the temperature produced by the radiation of any incandescent body, is inserted in the cylindrical chamber at a fixed distance from the opening of the conical vessel; hence the angle subtended by the heat rays projected by the radiating body towards the bulb of the thermometer, will remain constant whatever be the distance of that body from the instrument. Of course the radiation must be large enough to cover the entire field contained within the radial lines drawn from the bulb through the circumference of the opening of the conical vessel. We have already adverted to the fact that the temperature transmitted to the thermometer depends on the subtended angle. Consequently, by ascertaining practically what degree of temperature is imparted to the thermometer of the pyrometer, by a radiator of *known* intensity, we can determine the intensity of any other radiator by merely observing the temperature it imparts to that thermometer. It should be stated that in the pyrometers which have been constructed, the diameter of the opening of the conical vessel is ⅕th of the distance from the thermometer; hence the angle subtended is very nearly 11° 26′ Experiments made with an incandescent block of cast-iron, arranged as represented in the illustration, have shown that when the temperature of the block is 1930° above that of the surrounding atmosphere, the thermometer of the pyrometer indicates a temperature 20·7° higher than the circulating water in the casing. Applying the pyrometer in a similar manner, for ascertaining the temperature of a mass of overheated fused cast-iron, the indication of the thermometer has been found to reach 31·4° above that of the water in the enclosure. Now, the temperature of radiators is proportional to the radiant heat which they transmit, provided the subtended angles be alike; hence it follows that the temperature of the fused metal must be $\frac{31 \cdot 4 \times 1930}{20 \cdot 7} = 2940°$ above that of the water in the casing surrounding the conical vessel. Adding the latter temperature, viz. 60°, we ascertain that the actual temperature of the fused metal will be very nearly 3000°. The result of several experiments shows that this temperature corresponds with that determined by the practical expedient resorted to during the investigation, of melting wrought-iron in the fused mass. It should be mentioned that in constructing the scale of the new pyrometer, the radiant power corresponding with given subtended angles and given temperatures, has been ascertained with critical nicety by experiments conducted within a vacuum. For the purpose of demonstrating that the distances assumed by Mr. Williams in his reply to Lord Rosse are greatly exaggerated, a reference to the amount of radiant heat transmitted to the thermometer by the fused metal will no doubt be most convincing. We have before stated that the heat rays projected towards the thermometer from a flame produced by seventeen gas-jets subtend a mean angle of only 4° 9′, while the heat rays projected from the fused metal towards the thermometer of the pyrometer, subtend an angle of 11° 26′. The areas corresponding with these angles being $4 \cdot 15^2 : 11 \cdot 43^2 = 1 : 7 \cdot 6$, it follows that, unless the intensity of the gas flame is $3000° \times 7 \cdot 6 = 22800°$ F., it cannot transmit to the thermometer the same temperature as the fused metal, viz. 31·4° F. But Mr. Williams records an increment of temperature of 53° – 19° = 34° C. (61·2° F.); hence $\frac{61 \cdot 2 \times 22800}{31 \cdot 4} = 44723°$ F., must be the temperature of his flame, if twelve inches be a true distance.



Pyrometer for various intensities.

Having thus proved by demonstration that the distances assumed by Mr. Williams are exaggerated, let us now briefly examine the result of the experiments which have been made with an apparatus constructed agreeably to the description contained in his original communication. In carrying out these experiments, it was deemed necessary, before inserting the recording thermometer in a box as directed, to expose the same to the radiant heat of the flame, freely suspended in the atmosphere but carefully protected from currents of air by screens appropriately arranged. The horizontal gas-pipe with its perforations, ¼ inch between each, having been so adjusted that the distance between the central perforation and the thermometer was 14 in., the 17 jets were ignited, and the supply of gas regulated at precisely 5 cubic feet per hour. The temperatures imparted to the thermometer during the experiment are recorded in Table A. It will be seen on examining this table that the temperature imparted to the thermometer at the expiration of 36 minutes, was only 3·7° F., in place of 61·2° observed by Mr. Williams; the rate of discrepancy being thus 3·7 : 61·2 = 1 : 16·56.

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* NATURE, vol. vii. p. 28.

TABLE A.

Time.	Indication of Thermometer.	Temperature of surrounding Atmosphere.	Differential Temperature.
m. s.	Deg. Fah.	Deg. Fah.	Deg. Fah.
0 0	62·8	62·8	0·0
6 2	64·4	62·8	1·6
12 5	65·6	63·0	2·6
18 6	66·5	63·2	3·3
24 8	67·0	63·4	3·6
30 11	67·3	63·6	3·7
36 9	67·4	63·7	3·7

This extraordinary discrepancy between the temperatures published by Mr. Williams in his original communication, and the distances assumed in his reply to Lord Rosse, having been fully established by the experiment, the arrangement was changed, the thermometer being brought within 3 in. of the flames. But even at this short distance, the thermometer exposed to the radiant heat during an interval of 29 minutes, indicated a differential temperature of only 22·6° F., in place of 61·2° F. as stated by Mr. Williams—a fact clearly showing that the high temperature observed by him was owing to the intervention of the box in which he inserted the thermometer. Such a box composed of polished tin plate, open at the end presented towards the flame, was accordingly applied; its position being such that the space between the thermometer and the flame measured 3 in., as before. The 17 jets being ignited and the supply of gas regulated at 5 cubic feet per hour, the column of the thermometer rose rapidly, attaining a height of 136° in 20 minutes. Deducting the temperature of the surrounding air, 63·5°, the increment of heat proved to be 72·5°, thus showing that by the intervention of the box, the differential temperature was increased threefold. It scarcely requires explanation that owing to the close proximity of the flame the air in the box becomes heated, imparting its heat to the thermometer, by convection; while the reflection of the heat rays against the sides and bottom of the polished box, imparts radiant heat to those parts of the bulb which are not exposed to the direct radiation of the flame.

In view of the foregoing explanation it will be evident that, in a properly conducted experiment, the temperatures recorded in Mr. Williams' table cannot be produced unless the thermometer be placed even nearer than 3 in. from the flame. But admitting that the recorded temperatures could be developed at a distance of 3 in., it will be found that the mistake to which Lord Rosse has called attention is fatal to Mr. Williams' deductions. Referring to Table B, constructed in accordance with the theory pointed out by Lord Rosse in his letter to NATURE, it will be seen that each pair of jets so far from developing an equal amount of radiant energy, as indicated by Mr. Williams' table, they differ to a very great extent. For instance, while the two jets on each side of the centre develope respectively 1·11 and 0·90 (the energy transmitted by the central jet being represented by unity), the two outside jets develope respectively 2·77 and 0·51. Accordingly, the energy developed by the central pair will be 1·11 + 0·90 = 2·01, while the outside pair develope 2·77 + 0·51 = 3·28. Leaving out of sight the imperfections of the method adopted in making the observations, this great difference of the radiant energy transmitted to the thermometer by each pair of jets, is conclusive against the deduction concerning diathermacy of flame, which Mr. Williams has based on his published table of temperatures.

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TABLE B.

No. of jet from Thermometer.	Energy Transmitted.	No. of jet from Thermometer.	Energy Transmitted.
1	2·77	10	0·90
2	2·37	11	0·82
3	2·04	12	0·75
4	1·77	13	0·69
5	1·56	14	0·64
6	1·38	15	0·59
7	1·23	16	0·55
8	1·11	17	0·51
9	1·00		

SCIENTIFIC SERIALS

THE *Archives des Sciences Physiques et Naturelles* contains a long and admirable article by Prof. Plantamour, on the meteorology of Geneva and the Great St. Bernard for 1871, a year of very exceptional weather at these places. In a series of carefully compiled tables, the various meteorological phenomena observed are compared in every possible way, and deserve the study of meteorologists. The second paper is an exceedingly interesting one from the work published by M. de Candolle, "Histoire des Sciences et des savants depuis deux Siècles," &c., containing the result of much acute and original research, on Transformations of Movement among Organised Beings. The other two principal papers are one by M. Ernest Favre, on the Geology of the Ralligstöcke on the banks of Lake Thun, and one by MM. de la Rive and Sarasin on the rotation under magnetic influence of the electric discharge in rarefied gases, and on the mechanical action which this discharge may exercise in its movement of rotation.

Transactions of the Wisconsin Academy of Science, Arts, and Letters, 1870-72. This academy was organised in 1870, "by a convention called by the Governor and more than one hundred other prominent citizens of the State," its general objects being "the material, intellectual, and social advancement of the State," as well as, or rather by means of the advancement of, science, literature, and the arts. This first volume of Transactions contains some specimens of the work already done by the Academy in its various departments, to which is prefixed an extremely interesting *résumé* of what has already been done by Wisconsin for science. This is followed by a long list of papers on various subjects read before the Academy since its formation. Of the scientific papers contained in the volume before us, Dr. Lapham contributes one "On the Classification of Plants;" Mr. J. G. Knapp "On the Coniferæ of the Rocky Mountains;" Prof. Irving on "The Age of the Quartzites, Schists, and Conglomerate of Sank Co. Wisconsin;" Prof. Chamberlain a few suggestions, some of them original, as to a Basis for the Gradation of the Vertebrata; and Prof. Davies "On Potentials and their Application to Physical Science;" in which he attempts to give a *physical* interpretation to the potential function, and to illustrate it and its use by some simple examples. We hope the Academy will continue to produce as satisfactory work in the future as it has done since it commenced.

WE have received numbers 8, 9, 10, and 11 of the *Australian Mechanic and Journal of Science and Art* for August, September, October, and November, and highly creditable is the quality of the contents to its able editor, Mr. Ellery, Superintendent of Melbourne Observatory, and a hopeful sign of the intelligence and progress of the Australian people it is, that such a high-class scientific journal should have a paying circulation in so young a colony. Mr. Ellery himself is contributing a series of valuable and well-illustrated articles on "How to make and how to use a Spectroscope," while another contributor, "Delta," concludes in the August number a series of seven papers on "Spectrum Analysis." The subjects treated of are very various, and mostly practical, but whatever the subject of an article may be, science and the application of scientific principles are never lost sight of. There is a series of articles on agriculture, in which the application of science to this department of industry is well illustrated; and in an article on "Science and Government," principally with reference to the supply of coal, the writer concludes thus:—"There is scarcely any subject within the range of material science, however trifling it may at first appear, that has not a direct and important interest for the whole community, and especially for those who hold the responsibility of conducting the affairs and guarding the interests of the State." Would that all ministers would realise and act upon the great truth, so clearly and pithily expressed. Mr. Ellery contributes monthly a very valuable and interesting set of "Astronomical Notes," in which he gives all the details in a tabular form necessary to find out the positions, on the first of each month, of the planets, nebulæ, clusters, and double and other peculiar stars. We hope the journal will have all the success it well deserves.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 30.—Prof. George Busk, vice-president, in the chair. The following communications were read:—"Note on the Origin of *Bacteria*, and on their Relation to the Process of Putrefaction." By Dr. H. Charlton Bastian, F.R.S.

In his now celebrated memoir of 1862, M. Pasteur asserted and claimed to have proved (1) that the putrefaction occurring in certain previously boiled fluids after exposure to the air was due to the contamination of the fluids by *Bacteria*, or their germs, which had before existed in the atmosphere; and (2) that all the organisms found in such fluids have been derived more or less immediately from the reproduction of germs which formerly existed in the atmosphere.

The results of a long series of experiments have convinced me that both these views are untenable.

In the first place, it can be easily shown that living *Bacteria*, or their germs, exist very sparingly in the atmosphere, and that solutions capable of putrefying are not commonly infected from this source.

It has now been very definitely ascertained that certain fluids exist which, after they have been boiled, are incapable of giving birth to *Bacteria*, although they continue to be quite suitable for the support and active multiplication of any such organisms as may have been purposely added to them. Amongst such fluids I may name that now commonly known as "Pasteur's solution," and also one which I have myself more commonly used, consisting of a simple aqueous solution of neutral ammonic tartrate and neutral sodic sulphate.[*] When portions of either of these fluids are boiled and poured into superheated flasks, they will continue quite clear for many days, or even for weeks—that is to say, although the short and rather narrow neck of the flask remains open the fluids will not become turbid, and no *Bacteria* are to be discovered when they are submitted to microscopical examination.

But in order to show that such fluids are still thoroughly favourable media for the multiplication of *Bacteria*, all that is necessary is to bring either of them into contact with a glass rod previously dipped into a fluid containing such organisms. In about thirty-six hours after this has been done (the temperature being about 80° F.), the fluid, which had hitherto remained clear, becomes quite turbid, and is found, on examination with the microscope, to be swarming with *Bacteria*.[†]

Facts of the same kind have also been shown by Dr. Burdon Sanderson[‡] to hold good for portions of boiled "Pasteur's solution." Air was even drawn through such a fluid daily for a time, and yet it continued free from *Bacteria*.

Evidence of this kind has already been widely accepted as justifying the conclusion that living *Bacteria* or their germs are either wholly absent from, or, at most, only very sparingly distributed through the atmosphere. The danger of infection from the atmosphere having thus been got rid of and shown to be delusive, I am now able to bring forward other evidence tending to show that the first *Bacteria* which appear in many boiled infusions (when they subsequently undergo putrefactive changes) are evolved *de novo* in the fluids themselves. These experiments are moreover so simple, and may be so easily repeated, that the evidence which they are capable of supplying lies within the reach of all.

That boiling the experimental fluid destroys the life of any *Bacteria* or *Bacteria* germs pre-existing therein is now almost universally admitted. It may moreover be easily demonstrated. If a portion of "Pasteur's solution" be purposely infected with boiled *Bacteria* and subsequently boiled for two or three minutes, it will continue (if left in the same flask) clear for an indefinite period; whilst a similarly infected portion of the same fluid, not subsequently boiled, will rapidly become turbid. Precisely similar phenomena occur when we operate with the neutral fluid which I have previously mentioned; and yet M. Pasteur has ventured to assert that the germs of *Bacteria* are not destroyed in neutral or slightly alkaline fluids which have been merely raised to the boiling-point.[*]

Even M. Pasteur, however, admits that the germs of *Bacteria* and other allied organisms are killed in slightly acid fluids which have been boiled for a few minutes; so that there is a perfect unanimity of opinion (amongst those best qualified to judge) as to the destructive effects of a heat of 212° F. upon any *Bacteria* or *Bacteria* germs which such fluids may contain.

Taking such a fluid, therefore, in the form of a strong filtered infusion of turnip, we may place it after ebullition in a superheated flask with the assurance that it contains no living organisms. Having ascertained also by our previous experiments with the boiled saline fluids that there is no danger of infection by *Bacteria* from the atmosphere, we may leave the rather narrow mouth of the flask open, as we did in these experiments. But when this is done, the previously clear turnip infusion invariably becomes turbid in one or two days (the temperature being about 70° F.), owing to the presence of myriads of *Bacteria*.

Thus if we take two similar flasks, one of which contains a boiled "Pasteur's solution," and the other a boiled turnip infusion, and if we place them beneath the same bell-jar, it will be found that the first fluid remains clear and free from *Bacteria* for an indefinite period, whilst the second invariably becomes turbid in one or two days.

What is the explanation of these discordant results? We have a right to infer that all pre-existing life has been destroyed in each of the fluids; we have proved also that such fluids are not usually infected by *Bacteria* derived from the air—in this very case, in fact, the putrescible saline fluid remains pure, although the organic infusion standing by its side rapidly putrifies. We can only infer, therefore, that whilst the boiled saline solution is quite incapable of engendering *Bacteria*[†], such organisms are able to arise *de novo* in the boiled organic infusion.

Although this inference may be legitimately drawn from such experiments as I have referred to, fortunately it is confirmed and strengthened by the labours of many investigators who have worked under the influence of much more stringent conditions, and in which closed vessels of various kinds have been employed.[‡]

Whilst we may therefore infer (1) that the putrefaction which occurs in many previously boiled fluids when exposed to the air is not due to a contamination by germs derived from the atmosphere, we have also the same right to conclude (2) that in many cases the first organisms which appear in such fluids have arisen *de novo*, rather than by any process of reproduction from pre-existing forms of life.

Admitting, therefore, that *Bacteria* are ferments capable of initiating putrefactive changes, I am a firm believer also in the existence of not-living ferments under the influence of which putrefactive changes may be initiated in certain fluids—changes which are almost invariably accompanied by a new birth of living particles capable of rapidly developing into *Bacteria*.

"On Just Intonation in Music; with a description of a new Instrument for the easy control of all Systems of Tuning other than the ordinary equal Temperament." By R. H. M. Bosanquet.

The object of this communication is to place the improved systems of tuning within the reach of ordinary musicians; for this purpose the theory and practice are reduced to their simplest forms. A notation is described, adapted to use with ordinary written music, by which the notes to be performed are clearly distinguished. The design of a key-board is described, by which any system of tuning, except the ordinary equal temperament, can be controlled, if only the fifths of the system be all equal. The design is on a symmetrical principle, so that all passages and combinations of notes are performed with the same handling, in whatever key they occur. The theory of the construction of scales is then developed, and a diagram is given, from which the characteristics of any required system can be ascertained by inspection. An account is then given of the application of such systems to the new key-board, and particularly of a harmonium, which has been constructed, and contains at present the division of the octave into fifty-three equal intervals in a complete form. Rules for tuning are given. Finally, the application of the system of fifty-three to the violin is discussed.

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[*] In the proportion of 10 grains of the former and 3 of the latter to 1 ounce of distilled water.

[†] The Modes of Origin of Lowest Organisms, 1871, pp. 30, 51.

[‡] Thirteenth Report of the Medical Officer of the Privy Council (1871), p. 59.

[*] How unwarrantable such a conclusion appears to be, I have elsewhere endeavoured to show. See "Beginnings of Life," 1872, vol. i. pp. 326-333, and pp. 372-399.

[†] See "Beginnings of Life," vol. ii. p. 35, and vol. i. p. 463.

[‡] See a recent communication by Prof. Burdon Sanderson, in NATURE January 9.

Throughout the work of former labourers in the same field is reviewed; the obligations of the writer are due to Helmholtz, the late General T. Perronet Thompson, F.R.S., and others.

"On the Composition and Origin of the Waters of a Salt Spring in Huel Seton Mine, with a Chemical and Microscopical Examination of certain Rocks in its Vicinity." By J. Arthur Phillips.

After giving some tables, the author proceeds as follows:—A consideration of the various phenomena connected with the occurrence of this and other apparently similar springs, which have at different times been discovered in the district, would seem to lead to the inference that they all have some more or less direct communication with the sea, and that they are either the result of infiltration of sea-water through faults, or are true and independent sources which, before being tapped below the sea-level, had found their way to the ocean through faults or channels.

The following would appear, in the present state of our knowledge, a probable explanation of the origin of the Huel Seton spring. The cross-course is believed to extend through both granite and clay-slate to the sea. From the close contact of its surfaces, the presence of clay, and from other causes, this fault may be supposed not to be uniformly permeable by water, which can only follow a circuitous passage. In this way it penetrates to depths where reactions take place, which, although not entirely in accordance with the results of daily experience in our laboratories, can, after the investigations of M. Daubrée, M. de Sénarmont, and others, be readily understood. By the action of *sea-water* on *silicates of calcium*, *silicates of sodium* and *chloride of calcium* may be produced. The *sulphate of sodium* of the sea-water will be decomposed by this *chloride of calcium*, with the production of *sulphate of calcium* and *chloride of sodium*. The decomposition of clayey matter by *common salt* may produce *chloride of aluminium* and *silicates of sodium*, while the *magnesium* of the chloride of magnesium may be replaced by *calcium*; lastly, a portion of the *potassium* in the sea-water appears to have been replaced by the *lithium* of the granite.

Royal Geographical Society, Jan. 27.—Major-General Sir H. C. Rawlinson, K.C.B., president, in the chair.—"Journey from Bunder Abbas to Meshed, by Seistan," by Sir Frederick Goldsmid. The object of the author's journey was to carry into effect a settlement of the frontiers of Seistan, with which he had been entrusted. He left Bunder Abbas for the interior, with his party, on December 23, 1871, travelling in an E.N.E. direction first towards Bam. Beyond Bam and Azizabad, the country was fertile and well cultivated; this afterwards ceases, and near Fahraj the central desert begins. Beyond this, to the west, is another tract of mountainous country, bounding the fertile district of Seistan. The Hamun Lake was found dry, except pools of water at the mouths of the rivers, and the party crossed its southern part, where the bed was perfectly dry. Its limits are, however, well-marked by belts of reeds. The waters of the Helmund near and in the Delta had been led off by irrigation canals. The area of Seistan Proper was estimated at 947 square miles, and the population at 35,000. Majors St. John and Lovett, R.E., the surveyors attached to the party, had superintended the execution of a new wall-map of Persia, which was exhibited, and which gave quite a new character to the geography of many parts of Persia. The two great central areas of desert (1,500 to 3,000 feet above the sea-level) were clearly shown, and the snowy-ranges running in a north-west and south-east direction, nearly parallel to the Persian Gulf, well defined. One of these ranges rises to a height of more than 17,000 feet.—"On the Comparative Geography and Ethnology of Seistan," by the President. The country physically is dependent entirely on the River Helmund; and it is probable the earliest Aryan colonists drew off the whole of the water for irrigation, for in the earliest Geographical List, that contained in the "Vendidad," the country was called, not from the lake, but from the river. None of the sites of the cities and places named in ancient history could be identified with certainty. Seistan formed the most southerly province of the ancient Aryan country of Iran.

DIARY

THURSDAY, February 6.

Royal Society, at 8.30.—On the Osteology of Hyopotamidæ: Dr. W. Kowalevsky.—Magnetic Survey of Belgium in 1871: G. J. Perry.

Royal Institution, at 3.—Formation of Organic Substances: Dr. Armstrong.

Linnean Society, at 8.—Notes on Aristolochiaceæ: Dr. Masters.

Chemical Society, at 8.—On Anthrapurpurin: W. H. Perkin.—On the Solidification of Nitrous Oxide: T. Wells.—On Isomerism in the Terpene Family: Dr. C. A. Wright.

Society of Antiquaries, at 8.30.—On Donnington Castle: H. Goodwin.

FRIDAY, February 7.

Royal Institution, at 9.—Old Continents: Prof. Ramsay.

Geologists' Association, at 7.30.—Annual Meeting.—On the Diprionidæ of the Moffat Shale: Charles Lapworth.

Philological Society, at 8.15.

Archæological Institution, at 4.

Old Change Microscopical Society, at 5.30.—On the Internal Economy of Insects: T. Rymer Jones.

SATURDAY, February 8.

Royal Institution, at 3.—Comparative Politics: Dr. E. A. Freeman.

Royal Botanic Society, at 3.45.

MONDAY, February 10.

Royal Geographical Society, at 8.30.

London Institution, at 4.—Physical Geography: Prof. Duncan.

TUESDAY, February 11.

Photographic Society, at 8.—Annual Meeting.—The Achromatisation of an Object Glass: Prof. G. Stokes.

WEDNESDAY, February 12.

London Institution, at 7.—Fresco and Siliceous Painting: Prof. Barff.

Society of Arts, at 8.

Archæological Association, at 8.

THURSDAY, February 13.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

Mathematical Society, at 8.—On Systems of Linear Congruences: Prof. H. J. S. Smith.

BOOKS RECEIVED

English.—On a Hæmatozoon inhabiting Human Blood: T. R. Lewis, Calcutta.—A Report of Microscopical and Physiological Researches into the Nature of the Agent or Agents producing Cholera: T. R. Lewis and D. D. Cunningham.—The Useful Plants of India: Col. H. Drury. Second Edit. (W. H. Allen & Co.).—A Handbook of Hygiene: George Wilson (J. A. Churchill).—Chambers' Arithmetical Exercises: J. S. Mackay (W. & R. Chambers).—Standard Algebra (W. & R. Chambers).—Chambers' Elementary Physical Geography: J. Donald (W. & R. Chambers).—Chambers' Scientific Reader (W. & R. Chambers).—Chambers' Electricity: R. M. Ferguson (W. & R. Chambers).—Recollections of Canada: Lieut. Carlile, R.A., and Lieut.-Col. Martindale, Quebec (Chapman & Hall, London).

Foreign.—Die Kalkschwamme: eine Monographie. 3 vols. Ernest Haeckel (Williams & Norgate).—Gespinnst Fassern, &c.: Dr. R. Schlesinger (Williams & Norgate).

PAMPHLETS RECEIVED

English.—Potential Functions and their Applications in Physical Science: Prof. J. E. Davies.—Symon's Monthly Meteorological Magazine, No. 74, Vol. vii. January.—Quarterly Journal of Education, No. 5, January (Groombridge).—Messenger of Mathematics, No. 21, January (Macmillan & Co).

Foreign.—Correspondenzblatt des Naturforcher: Riga.—Sulla Corona Sollare: Prof. L. Respighi.

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THURSDAY, FEBRUARY 13, 1873

MODERN APPLICATIONS OF THE DOCTRINE OF NATURAL SELECTION[*]

NOTWITHSTANDING the objections which are still made to the theory of Natural Selection on the ground that it is either a pure hypothesis not founded on any demonstrable facts, or a mere truism which can lead to no useful results, we find it year by year sinking deeper into the minds of thinking men, and applied, more and more frequently, to elucidate problems of the highest importance. In the works now before us we have this application made by two eminent writers, one a politician, the other a naturalist, as a means of working out so much of the complex problem of human progress as more especially interests them.

Mr. Bagehot takes for granted that early progress of man which resulted in his separation into strongly marked races, in his acquisition of language, and of the rudiments of those moral and intellectual faculties which all men possess; and his object is to work out the steps by which he advanced to the condition in which the dawn of history finds him,—aggregated into distinct societies known as tribes or nations, subject to various forms of government, influenced by various beliefs and prejudices, and the slave of habits and customs which often seem to us not only absurd and useless, but even positively injurious. Now every one of these beliefs or customs, or these aggregations of men into groups having some common characteristics, must have been useful at the time they originated; and a great feature of Mr. Bagehot's little book is his showing how even the most unpromising of these, as we now regard them, might have been a positive step in advance when they first appeared. His main idea is, that what was wanted in those early times was some means of combining men in societies, whether by the action of some common belief or common danger, or by the power of some ruler or tyrant. The mere fact of obedience to a ruler was at first much more important than what was done by means of the obedience. So, any superstition or any custom, even if it originated in the grossest delusion, and produced positively bad results, might yet, by forming a bond of union more perfect than any other then existing, give the primitive tribe subject to it such a relative advantage over the disconnected families around them, as to lead to their increase and permanent survival in the struggle for existence. In those early days war was perhaps the most powerful means of forcing men to combined action, and might therefore have been necessary for the ultimate development of civilisation. Freedom of opinion was then a positive evil, for it would lead to independent action, the very thing it was most essential to get rid of. In early times isolation was an advantage, in order that these incipient societies might not be broken up by intermixture, and it was only after a large number of such little groups, each with its own idiosyncrasies, habits, and beliefs, had been formed, that it became advantageous for them to meet to intermingle or to struggle together, and the stronger to drive out or exterminate the weaker. Out of the great number of petty tribes thus formed, only a few had the qualities which led to a further advancement. The rest were either exterminated or driven out into remote and inaccessible or inhospitable districts, and some of those are the "savages" which still exist on the earth, serving as a measure of the vast progress of the human race. Yet even these never show us the condition of the primitive man; they are men who advanced up to a certain point and then became stationary:—

> "Their progress was arrested at various points; but nowhere, not even in the hill tribes of India, not even in the Andaman Islands, not even in the savages of Terra del Fuego, do we find men who have not got some way. They have made their little progress in a hundred different ways; they have framed with infinite assiduity a hundred curious habits; they have, so to say, *screwed* themselves into the uncomfortable corners of a complex life, which is odd and dreary, but yet is possible. And the corners are never the same in any two parts of the world. Our record begins with a thousand unchanging edifices, but it shows traces of previous building. In historic times there has been but little progress, in prehistoric times there must have been much."

Again our author shows how valuable must have been the institution of caste in a certain stage of progress. It established the division of labour, led to great perfection in many arts, and rendered government easy. Caste nations would at first have a great advantage over non-caste nations, would conquer them and increase at their expense. But a caste nation at last becomes stationary; for a habit of action and a type of mind which it can with difficulty get rid of is established in each caste. When this is the case, non-caste nations soon catch them up, and rapidly leave them far behind.

This outline will give some idea of the way in which Mr. Bagehot discusses an immense variety of topics connected with the progress of societies and nations and the development of their distinctive peculiarities. The book is somewhat discursive and sketchy, and it contains many statements and ideas of doubtful accuracy, but it shows an abundance of ingenious and original thought. Many will demur to the view that mere accident and imitation have been the origin of marked national peculiarities; such as those which distinguish the German, Irish, French, English, and Yankees: "The accident of some predominant person possessing certain peculiarities set the fashion, and it has been imitated to this day"; and again, "Great models for good or evil sometimes appear among men who follow them either to improvement or degradation." This is said to be one of the chief agents in "nation-making," but a much better one seems to be the affinity of like for like, which brings and keeps together those of like morals or religion or social habits; but both are probably far inferior to the long-continued action of external nature on the organism, not merely as it acts in the country now inhabited by the particular nation, but by its action during remote ages and throughout all the migrations and intermixtures that our ancestors have ever undergone. We also find many broad statements as to the low state of morality and of intellect in all prehistoric men, which facts hardly warrant, but this is too wide a question to be entered upon here. In the concluding chapter, "The Age of Discussion," there are some excellent remarks on the restlessness and desire for immediate action which civilised men inherit from their savage ancestors, and how much it has hindered true progress; and the following passage, with which we will conclude the notice of Mr. Bagebot's book, might do much good if by means of any skilful surgical operation it could be firmly fixed in the minds of our legislators and of the public:—

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[*] "Physics and Politics; or, Thoughts on the Application of the Principles of 'Natural Selection' and 'Inheritance' to Political Society." By Walter Bagehot. (King and Co., 1872.)

"Histoire des Sciences et des Savants depuis deux Siècles suivie d'autres études sur les Sujets Scientifiques en particulier sur la Sélection dans l'Espèce Humaine." Par Alphonse de Candolle. (Genève: H. Georg, 1873.)

> "If it had not been for quiet people, who sat still and studied the sections of the cone, if other people had not sat still and worked out the doctrine of chances, the most 'dreamy moonshine,' as the purely practical mind would consider, of all human pursuits; if 'idle star-gazers' had not watched long and carefully the motions of the heavenly bodies, our modern astronomy would have been impossible; and without astronomy, 'our ships, our colonies, our seamen,' all that makes modern life, could not have existed. Ages of quiet, sedentary, thinking people were required before that noisy existence began, and without those pale preliminary students, it never could have been brought into being. And nine-tenths of modern science is, in this respect, the same; it is the produce of men whom their contemporaries thought dreamers—who were laughed at for caring for what did not concern them—who, as the proverb went, 'walked into a well from looking at the stars'—who were believed to be useless, if anyone could be such. And the conclusion is plain, that if there had been more such people, if the world had not laughed at those there were, if rather it had encouraged them, there would have been a great accumulation of proved science ages before there was. It was the irritable activity, the 'wish to be doing something,' that prevented it. Most men inherited a nature too eager and too restless to find out things; and even worse—with their idle clamour they 'disturbed the brooding hen,' they would not let those be quiet who wished to be so, and out of whose calm thought much good might have come forth. If we consider how much good science has done, and how much it is doing for mankind, and if the over-activity of men is proved to be the cause why science came so late into the world, and is so small and scanty still, that will convince most people that our over-activity is a very great evil."

In the second work, of which we have given the title, the veteran botanist, Alphonse de Candolle, sets forth his ideas on many subjects not immediately connected with the science in which he is so great an authority. The most important, though not the longest, essay in the volume is that on "Selection in the Human Race," in which he arrives at some results which differ considerably from those of previous writers. In a section on "Selection in Human Societies or Nations," we find a somewhat novel generalisation as to the progress and decay of nations. Beginning with small independent states, we see a gradual fusion of these into larger and larger nations, sometimes voluntary, sometimes by conquest, but the fusion always goes on, and tends to become more and more complete, till we have enormous aggregations of people under one government, in which local institutions gradually disappear, and result in an almost complete political and social uniformity. Then commences decay; for the individual is so small a unit, and so powerless to influence the Government, that the mass of men resign themselves to passive obedience. There is then no longer any force to resist internal or external enemies, and by means of one or the other the "vast fabric" is dismembered, or falls in ruins. The Roman Empire, and the Spanish Possessions in America, are examples of this process in the past; the Russian Empire and our Indian Possessions will inevitably follow the same order of events in a not very distant future.

Although M. de Candolle is a firm believer in Natural Selection, he takes great pains to show how very irregular and uncertain it is in its effects. The constant struggles and wars among savages, for example, might be supposed to lead to so rigid a selection, that all would be nearly equally strong and powerful; and the fact that some savages are so weak and incapable as they are, shows, he thinks, that the action of natural selection has been checked by various incidental causes. He omits to notice, however, that the struggle between man and the lower animals was at first the severest, and probably had a considerable influence in determining race-characters. It may be something more than accidental coincidence that the most powerful of all savages—the negroes—inhabit a country where dangerous wild beasts most abound; while the weakest of all—the Australians—do not come into contact with a single wild animal of which they need be afraid.

Selection among barbarous nations will often favour cunning, lying, and baseness; vice will gain the advantage, and nothing good will be selected but physical beauty. Civilisation is defined by the preponderance of three facts—the restriction of the use of force to legitimate defence and the repression of illegitimate violence, speciality of professions and of functions, and individual liberty of opinion and action under the general restriction of not injuring others. By the application of the above tests we can determine the comparative civilisation of nations; but too much civilisation is often a great danger, for it inevitably leads to such a softening of manners, such a hatred of bloodshed, cruelty, and injustice as to expose a nation to conquest by its more warlike and less scrupulous neighbours. Progress in civilisation must necessarily be very slow, and to be permanent must pervade all classes and all the surrounding nations; and it is because past civilisations have been too partial that there have been so many relapses into comparative barbarism. All this is carefully worked out, and is well worthy of attention.

In the last section, on the probable future of the human race, we have some remarkable speculations, very different from the somewhat utopian views held by most evolutionists, but founded nevertheless on certain very practical considerations. In the next few hundred or a thousand years the chief alterations will be the extinction of all the less dominant races, and the partition of the world among the three great persistent types, the whites, blacks, and Chinese, each of which will have occupied those portions of the globe for which they are best adapted. But, taking a more extended glance into the future, of 50,000 or 100,000 years hence, and supposing that no cosmical changes occur to destroy, wholly or partially, the human race, there are certain well-ascertained facts on which to found a notion of what must by that time have occurred. In the first place, all the coal and all the metals available will then have been exhausted, and even if men succeed in finding other sources of heat, and are able to extract the metals thinly diffused through the soil, yet these products must become far dearer and less available for general use than now. Railroads and steamships, and everything that depends upon the possession of large quantities of cheap metals, will then be impossible, and sedentary agricultural populations in warm and fertile regions will be the best off. Population will have lingered longest around the greatest masses of coal and iron, but will finally become most densely aggregated within the tropics. But another and more serious change is going on, which will result in the gradual diminution and deterioration of the terrestrial surface. Assuming the undoubted fact that all our existing land is wearing away and being carried into the sea, but by a strange oversight, leaving out altogether the counteracting internal forces, which for countless ages past seem always to have raised ample tracts above the sea as fast as subaërial denudation has lowered them, it is argued that, even if all the land does not disappear and so man become finally extinct, yet the land will become less varied and will consist chiefly of a few flat and parched-up plains, and volcanic or coralline islands. Population will by this time necessarily have much diminished, but it is thought that an intelligent and persevering race may even then prosper. "They will enjoy the happiness which results from a peaceable existence, for, without metals or combustibles it will be difficult to form fleets to rule the seas or great armies to ravage the land;" and the conclusion is that, "such are the probabilities according to the actual course of things." Now, although we cannot admit this to be a probability on the grounds stated by M. de Candolle, it does seem a probability, at some more distant epoch, on other grounds. The great depths of the oceans extend over wide areas, whereas the great heights of the land are only narrow ridges and peaks; hence it has been calculated that the mean height of the land is only 1,000 feet, while the mean depth of the sea is about 15,000 feet. But the sea is 2½ times as extensive as the land, so that the bulk or mass of the land above the sea level will be only about one thirty-seventh of the mass of the ocean. Now, does not this small proportion of bulk of land to water render it highly probable that the forces of elevation and depression should sometimes cause the total or almost total submersion of the land? Of such an epoch no geological record could be left because there could be no strata formed, except from the *débris* of coral islands, and such a period of destruction of the greater part of terrestrial life may have repeatedly occurred between the period when the several Primary or Secondary formations were deposited. At all events, with such a proportion of land and sea surface as now exists, with such a small bulk of land above the enormous bulk of water, and with no known cause why the dry land rather than the sea-bottom should be constantly elevated, we must admit it to be almost certain that great fluctuations of the area of the land must occur, and that, while those fluctuations could not very considerably increase the area of the land they might immensely diminish it. There is here, therefore, a cause for the possible depopulation of the earth likely to occur much sooner than any cosmical catastrophe.

The largest and most elaborate essay in the volume is that on the "History of the Sciences and of Scientific Men for the last two Centuries." In this the author endeavours to arrive at certain conclusions as to the progress of science under different conditions and in different countries, the influence of political institutions and of heredity, and various other phenomena, by a method which is novel and ingenious. He takes account only of the men honoured as foreign associates or members by the three great European Scientific bodies, the Royal Society of London and the Paris and Berlin Academies. By this means he avoids all personal bias, and secures, on the whole, impartiality. The tables drawn out by this method are examined in every possible way, and the results worked out in the greatest detail. The main conclusion arrived at is the determination of a series of eighteen causes favourable to the progress of science; and it is shown that a large proportion of these are present in a considerable degree in countries where science flourishes, while they are almost wholly absent in barbarous or semi-civilised countries where science does not exist.

Another interesting essay is that on the importance for science of a dominant language, and it contains some very curious facts as to the way in which the English language is spreading on the Continent M. de Candolle believes that in less than two centuries English will be the dominant language, and will be almost exclusively used in scientific works.

There are also short but very interesting essays on methods of teaching drawing and developing the observing powers of children, on statistics and free will, and on a few other subjects of less importance, all of which are treated in a thoughtful manner, and illustrate one of the views on which much stress is laid in this work, viz., that the mental faculties which render a man great in any science are not special, but would enable him to attain equal eminence in many other branches of science or in any professional or political career.

ALFRED R. WALLACE

HÄCKEL ON SPONGES

Die Kalkschwämme. Eine Monographie. Von Ernst Häckel. 2 vols., with an additional vol. of 60 lithographic plates. (Berlin, 1872.)

THIS splendid contribution to the knowledge of the sub-class of Calcareous Sponges is worthy of the high reputation of Prof. Häckel. In the preface he speaks of it as one of the many results of the stimulus given to zoology by the Darwinian Theory; and the list of those who have contributed the materials on which this monograph is based is honourable alike to the author and to the friendly helpers from our own and every other civilised country. It includes the names of Agassiz from the United States, Allman from Edinburgh, Percival Wright from Dublin, Barboza du Bocage from Lisbon, Lacaze Duthiers from Paris, the lamented Claparède from Geneva, Eschmark and Sars from Christiania, Steenstrup from Copenhagen, and Lieberkühn, Peters, Oscar Schmidt, Semper, von Siebold and many others from Germany. In addition to this, the author has himself collected sponges in Heligoland, Nice, Naples, Messina, the Canaries and Mogador, Algesiras, Bergen, and the neighbouring Norwegian coast, and lastly in the Adriatic Sea.

With this admirable material, and, what is no less important, with the philosophical spirit which a mere specialist always lacks, it is no wonder that a work of the first importance has been produced.

The first chapter gives an appreciative account of the admirable labours of Prof. Grant, and of the subsequent contributions to the subject by Johnston, Bowerbank, Lieberkühn, Carter, Oscar Schmidt, and Kölliker. The defects of Mr. Bowerbank's "Monograph of British Sponges" are clearly pointed out, but its great merits receive equally cordial recognition, while the criticism passed on Dr. Gray's "Classification" is as just as it is severe.

After a description of the methods of examination, the author proceeds to give a detailed account of the anatomy and natural history of the calcareous sponges, and this occupies the greater part of the first volume. The second is devoted to a detailed description of the whole group in systematic order, with diagnosis of species and ample synonomy. The plates in the third volume, drawn by Prof. Häckel with the camera lucida, are admirably exact, though artistic effect is sometimes sacrificed to a somewhat diagrammatic clearness. They remind one of the excellent illustrations of Bronn's "Thierreich."

The class of sponges is divided into *Fibrospongiæ*, including most of Grant's and Bowerbank's siliceous and ceratose genera, *Myxospongiæ*, represented by *Halisarca* and *Calcispongiæ vel Grantiæ*. This third class contains three families, Ascones (Leucosolenia Bowerbank), Leucones (Leuconia Bowerbank), and Sycones (Grantia Bowerbank), represented by *Ascetta*, *Leucetta* and *Sycetta* respectively. The genera are chiefly characterised by their spicula.

The author agrees with Oscar Schmidt in deducing all known sponges from a single primitive form (Archispongia, Protospongia), which he supposed to have resembled *Halisarca* more than any other existing genus. He regards the class as very distinct from the Protozoa, and most nearly related to the Cœlenterata, a view with which English readers are familiar from Mr. E. R. Lankester's interesting paper on Zoological Affinities of Sponges in the Annals and Magazine of Natural History (vol. vi. 1870). Indeed it was the position taken by Leuchart himself in 1854, seven years after the sub-kingdom of Cœlenterata had been established by himself and Frey. If we admit that each sponge-pyramid is not a colony of Protozoa, but a multicellular organism, its likeness to a polyp is very striking: the chief differences are the absence of tentacles and of thread-cells. The latter structures, however, have, we believe, been detected in some Mediterranean sponges since the publication of Prof. Häckel's work.

Comparing the "Stammbaum" given at the end of the first volume with that in the third edition of the "Schöpfungsgeschichte" (1872), published five months earlier, we find that the author now makes all sponges descend through "Archispongia," and "Protascus" from an equally hypothetical "Gastræa," while the Cœlenterata diverge from Protascus as Archydra. This makes the affinity less close between Myxospongiæ on the one hand, and between Calcispongiæ and Coralligena on the other. The modification brings the Stammbaum nearer to the classifications actually used by other zoologists and is so far an advantage.

With regard to nomenclature, Prof. Häckel defends the proposal which he made in 1869 to revive the old name of Zoophyta (used by our countryman Wotton in 1552) in order to include sponges (or Porifera) and Cœlenterata (or, as he prefers to call them, Acalephæ). Admitting the justice of the classification, there seems no sufficient justification for the change of names. 1. Priority belongs to the name given by those who first establish true affinities, and not to vague and fanciful names given two hundred years before Linnæus. 2. To say "Zoophyta" is no worse a name to revive than "Vermes" is sufficiently to condemn it. 3. Whether the cavity in a sea-anemone is all stomach or partly perivisceral may admit of dispute, but "Cœlenterata" only affirms that the animal is hollow; and if the term suggests either interpretation, it rather lends itself to Prof. Häckel's. 4. If another word must be invented to apply to Anthozoa (or "Coralla") and Hydrozoa (or "Hydromedusæ") in common, Huxley's "Nematophora," suggested in 1851, is just as good as "Acalephæ," which was used in a more restricted sense by Cuvier. But it is not impossible that before long neither term will be properly exclusive of sponges.

These perpetual changes of names and invention of fresh ones to fit kinsfolk of every shade of propinquity and even avowedly mythological ancestors, is a real drawback to the value of such excellent works as this, and is almost as bad as the endless nomenclature of the species-mongers with whom Prof. Häckel is so justly indignant. However the new wine is still working, and we may say of even "endless genealogies"—

> "Doch sind wir auch mit diesen nicht gefährdet,
> In wenig Jahren wird es anders sein:
> Wenn sich der Most auch ganz absurd geberdet,
> Es gibt zuletzt doch noch 'nen Wein."

And this book will remain an important contribution to philosophical zoology, no less than to the special history of the group to which it is devoted. P. S.

OUR BOOK SHELF

Grotesque Animals. Invented, Drawn, and Described by E. W. Cooke, R.A., F.R.S., F.G.S., F.Z.S., &c. (London: Longmans, Green, and Co., 1872.)

MR. E. W. COOKE possesses so high a reputation, not only as one of the leading artists of the day, but also as a man eminently devoted to science, as evidenced by the fact of his having attained the double distinction of Royal Academician and Fellow of the Royal Society, that anything proceeding from his pencil cannot fail to be worthy of notice, and we have accordingly looked through this quaint collection of facsimile drawings with very great interest. Mr. Cooke states, in his preface, that he commenced this series of "grotesque combinations," to which he also assigns the euphonious title of "Entwickelungsgeschicte" (history of development), while seeking rest and relief on the Somersetshire Coast after the dissipation attendant upon the meeting of the British Association at Manchester, in 1864, and that the idea of publication was forced upon him by friends who wished to have copies of the drawings. We are not surprised at his numerous friends and admirers desiring that these results of his holiday recreations should be given to the world; for, apart from the merits of the drawings in an artistic point of view, containing, as they do, powerful delineations of animal forms, they exhibit a singular and amusing fertility of imagination, the *disjecta membra* of birds, beasts, and fishes, being worked up together in a variety of fantastic forms which it would puzzle Mr. Darwin or Professor Owen to classify. The plates are accompanied by short descriptions, also by Mr. Cooke, and intended, he says, "as a key to aid the unintiated in animal lore." We give our readers the following descriptions as a sample:—"Plate v. No. 1. An odd fish—Platax—with dress of a bivalve shell, *Pecten Gibbosus.* The feet of a sprat-loon, *Colymbus Stellatus*, and tail of Beroe. No. 2. *Encrinus entrocha*, a Lily-encrinite, wears the head-dress of a porpita, one of the Acalephæ. Her dress being of Flustra, her right arm is a Pentelasmis, her left a species of Serpula. No. 3. This pig-faced lady, whose body is '*Parasmilia centralis*,' has wings of *Avicula cygnipes* (both species from the chalk), and limbs of a bird (species unknown). . . Plate x. No. 1. This scaly creature, capped by Cephalaspis, has the feet of a Brazilian porcupine, the heterocercal tail of a Palæozoic fish, and the lower jaw and tusks of Dinotherium wherewith to scratch himself. . . Plate xiii. No. 3. This ancient spinster, truly Palæozoic, has the triturating teeth of a fish, *Cestracion Philipi*; her cap is an Argonauta, her body that of the Port Jackson shark, her fan (Spanish, of course) a Renilla. *Isis hippuris* furnishes her arms . . . Plate xviii. No. 1. This hollow character, formed of the lower jaw of the hippopotamus, has very diverse arms, the right being an Ancyloceras, the left *Hamites attenuatus.* His head-gear is well got up with hide, horns, and the beak of a spoonbill! . . . Plate xx. No. 1, thanks to Monte Bolca and its elevated strata of *dried* fish, we have *Semiophorus vellifer* (a fish of the Eocene.) With Scutes on his neck, and the claws of a lion, he walks his chalks; an upper cretaceous shell, *Plagiostoma spinosum*, defends his body." Many of the plates remind us of the gambols of the crustaceæ and other marine animals in *Babil and Bijou*, and we have no doubt that Mr. Boucicault, in his next attempt to "improve the British Drama," will find in this volume an endless variety of suggestions for humorous stage effects. We must not omit to mention the admirable manner in which the drawings have been reproduced by Mr. Sawyer of the Autotype Fine Art Company, the plates being exact facsimiles of the drawings. We anticipate an extensive circulation for this beautifully-executed and entertaining work. G. I. F. C.

Abstract of the Reports of the Surveys and other Geographical Operations in India for 1870-71.

We learn from these reports that during the season of 1870-71, the Great Trigonometrical Survey has been proceeded with on six series, and the complete work is represented by 11,203 square miles of principal, and 10,076 of secondary triangulation. The total area surveyed up to 1871 by the Topographical Surveys which do not include the Topographical work of the Trigonometrical Survey, is 665,909 square miles, three times the area of France. The Geological Survey has been going on more briskly than in previous years, and the Geological Surveyors are gradually building up the materials which will enable a geological map of India to be prepared. The tidal observations, from which much was expected, and for which gauges were made and sent out to India more than two years ago, were not gone on with on account of the financial difficulties of the Indian government. The government has finally adopted Mr. Hunter's plan for the spelling of Indian names; it is as near an approach to what is known as the "scientific system," as the public in the present state of education are able to endure. The "scientific system" consists in scrupulously rendering letter for letter, without any particular care to preserve the pronunciation. Uniformity in the spelling of geographical names is a great matter, no matter on what principle it may be based.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Inherited Instinct

The following letter seems to me so valuable, and the accuracy of the statements vouched for by so high an authority, that I have obtained permission from Dr. Huggins to send it for publication. No one who has attended to animals either in a state of nature or domestication will doubt that many special fears, tastes, &c., which must have been acquired at a remote period, are now strictly inherited. This has been clearly proved to be the case by Mr. Spalding with chickens and turkeys just born, in his admirable article recently published in *Macmillan's Magazine.* It is probable that most inherited or instinctive feelings were originally acquired by slow degrees through habit and the experience of their utility; for instance the fear of man, which as I showed many years ago, is gained very slowly by birds on oceanic islands. It is, however, almost certain that many of the most wonderful instincts have been acquired independently of habit, through the preservation of useful variations of pre-existing instincts. Other instincts may have arisen suddenly in an individual and then been transmitted to its offspring, independently both of selection and serviceable experience, though subsequently strengthened by habit. The tumbler-pigeon is a case in point, for no one would have thought of teaching a pigeon to turn head over heels in the air; and until some bird exhibited a tendency in this direction, there could have been no selection. In the following case we see a specialised feeling of antipathy transmitted through three generations of dogs, as well as to some collateral members of the same family, and which must have been acquired within a very recent period. Unfortunately it is not known how the feeling first arose in the grandfather of Dr. Huggins's dog. We may suspect that it was due to some ill-treatment; but it may have originated without any assignable cause, as with certain animals in the Zoological Gardens, which, as I am assured by Mr. Bartlett, have taken a strong hatred to him and others without any provocation. As far as it can be ascertained, the great-grandfather of Dr. Huggins's dog did not evince the feeling of antipathy, described in the following letter.

Charles Darwin

"I wish to communicate to you a curious case of an inherited mental peculiarity. I possess an English mastiff, by name Kepler, a son of the celebrated Turk out of Venus. I brought the dog, when six weeks old, from the stable in which he was born. The first time I took him out he started back in alarm at the first butcher's shop he had ever seen. I soon found he had a violent antipathy to butchers and butchers' shops. When six months old, a servant took him with her on an errand. At a short distance before coming to the house, she had to pass a butcher's shop; the dog threw himself down (being led with a string), and neither coaxing nor threats would make him pass the shop. The dog was too heavy to be carried; and as a crowd collected, the servant had to return with the dog more than a mile, and then go without him. This occurred about two years ago. The antipathy still continues, but the dog will pass nearer to a shop than he formerly would. About two months ago, in a little book on dogs published by Dean, I discovered that the same strange antipathy is shown by the father, Turk. I then wrote to Mr. Nichols, the former owner of Turk, to ask him for any information he might have on the point. He replied—'I can say that the same antipathy exists in King, the sire of Turk, in Turk, in Punch (son of Turk, out of Meg) and in Paris (son of Turk, out of Juno). Paris has the greatest antipathy, as he would hardly go into a street where a butcher's shop is, and would run away after passing it. When a cart with a butcher's man came into the place where the dogs were kept, although they could not see him, they all were ready to break their chains. A master-butcher, dressed privately, called one evening on Paris's master to see the dog. He had hardly entered the house before the dog (though shut in) was so much excited that he had to be put into a shed, and the butcher was forced to leave without seeing the dog. The same dog at Hastings made a spring at a gentleman who came into the hotel. The owner caught the dog and apologised, and said he never knew him to do so before, except when a butcher came to his house. The gentleman at once said that was his business. So you see that they inherit these antipathies, and show a great deal of breed.' "WILLIAM HUGGINS"

The unreasonable

MY attention has directed itself to a letter by Dr. Ingleby in your last number, containing two curious but inconsistent misrepresentations of my words, and therein something that, if the writer were not Dr. Ingleby, might be called an instructive instance of cynophatnism or doggimangerness—the behaviour of one who will neither understand a thing himself, nor allow other folk to understand it. As, however, the writer is Dr. Ingleby, I feel sure that a less cursory contemplation of the matter will modify his views.

The following doctrines are in the *Kritik* :—

1. At the basis of the natural order is a transcendental object.

   "Das *transcendentale Object*, welches den aüsseren Erscheinungen, ingleichen das, was der inneren Anschauung zum Grunde liegt, ist weder Materie, noch ein denkendes Wesen an sich selbst, sondern ein uns unbekannter Grund der Erscheinungen, die den empirischen Begriff von der ersten sowohl als zweiten art an die Hand geben." (IVth Paralogism, of Ideality ; *First Edition.*)

2. The transcendental object is *unreasonable*, or evades the processes of human thought.

   (*a*) Of the sensibility :—

   "Die nichtsinnliche . . . Ursache dieser Vorstellungen ist uns gänzlich unbekannt, und diese können wir daher nicht als Object anschauen." . . . (VIth section of Antithetic.)

   (*b*) Of the understanding :—

   "Unser Verstand . . Dinge an sich selbst (nicht als Erscheinungen betrachtet) *Noumena* nennt. Aber er setzt sich auch sofort selbst Grenzen, sie durch keine Kategorien zu erkennen, mithin sie nur unter dem Namen eines unbekannten Etwas zu denken." (Ground of distinction between Phenomena and Noumena.)

3. The doctrine of the contradictions is one means by which we know this.

   "Mann kann aber auch umgekehrt aus dieser Antinomie . . . die transcendentale Idealität der Erscheinungen . . . indirect . . . beweisen," &c. (VIIth section of Antithetic.)

The Kantian theory had two legs to stand upon; one the alleged necessity of mathematical axioms, the other these alleged necessary contradictions in our ideas of the natural order. How completely the first has been amputated I hope to have shortly an opportunity of showing in a course of lectures at the Royal Institution. The doctrine, that we may infer the existence of an unknowable from supposed contradictions in the knowable, "has been developed and extended by the great successors of Kant;" and when in "a later form" these contradictions were set forth from an ultimately empirical standpoint (*not* that of Hamilton, but of Spencer, as stated in my note) the doctrine became fit for notice in a scientific lecture. Only the contradictions themselves, however, could be criticised, and not the step from them to the existence of the unknowable, or the unknowability of the existent. And Kant's name could only be mentioned as the historical starting-point of the doctrine; whose importance for the empiricist is mainly due to the modifications it has undergone since his time.

If Dr. Ingleby will kindly look at my lecture (*Macmillan's Magazine*, October 1872) again, he will see that I have attributed to Kant no more than the above-quoted doctrines; that I never pretended to expound Kant's form of them, or their relation to the rest of his system; and that I never said nor accused anybody of saying either that the antithetic was unreasonable, or that any natural order of thought or things was unreasonable. In regard to the other misrepresentations he speaks of, I shall be very glad indeed to be told of them, and to be set right, provided only they exist in my words, and not in the exuberant imagination of my critic.

London, Feb. 9 W. K. CLIFFORD

P.S.—There is an important error in p. 508 of the lecture in question. The surface-tension of camphor and water is *less* than that of water, not *greater*, as there stated. The general argument depends only on there being a difference.

Prof. Clifford on Curved Space

THE friend, who (as I stated in my letter in NATURE, Feb. 6) called my attention to Prof. Clifford's address in *Macmillan's Magazine* for October last, asked me certain questions respecting curved space, which I was quite unable to answer: and another friend, occupying the foremost place among English philosophers, has since communicated to me the great discomfort which Prof. Clifford's views had occasioned him, and suggested that I should comment upon them in NATURE. I am not sure that what I have to say will prove to be helpful either to my discomforted friend, or to truth: yet the doctrine of curved space is so extraordinary in itself, and so momentous in its consequences, if it be true, that it is a fair subject for sceptical scrutiny. Moreover, I do not conceive that in commenting upon it I am going *ultra crepidam*; for the nature of space is not a subject on which the mathematician can claim a monopoly. *In limine* allow me to express my regret that Prof. Clifford should have selected such a topic for the entertainment of a popular audience. It is quite incredible that any of his hearers could have apprehended his meaning. There was assuredly no need for the lecturer to have cast a glamour on their mental eye by the invocation of those awful names, Lobatchewsky and Gauss, Riemann and Helmholtz.

The principle, in exemplification of which Prof. Clifford expounded the doctrine in question, was this: that a law can be only provisionally universal (*i.e.* as "we find that it pays us to assume it"), but that it is theoretically universal, or true of all cases whatever, "is what we do not know of any law at all" p. 504. I fancy he would not include numerical formulæ under the term "law:" else arithmetic and algebra would afford an infinity of examples of such a law. Be that as it may, he does not select an example from either of those sciences, but from Euclidian geometry. He takes the proposition established by Euclid, that in any plane triangle the three angles added together are equal to two right angles. This he asserts we do not know as a universal truth. I now quote his own words: "Now suppose that three points are taken in space, distant from one another as far as the sun is from a Centauri, and that the shortest distances between these points are drawn so as to form a triangle: and suppose the angles of this triangle to be very accurately measured and added together; this can at present be done so accurately that the error shall certainly be less than one minute. . . . Then I do not know that this sum [? apart from the question of error] would differ at all from two right angles; but also I do not know that the difference would be less than 10°." If, then, after a sufficient number of observations it were found that the deviation were greater than the assigned limit of error (less than one minute), it would follow that the Euclidian law is not universal, and that for triangles of such dimensions it is not true. The conclusion would be, then, that our Tridimensional space is not a homaloid. We need not run our heads against the ghost of a fourth dimension; for the refinements of the geometer enable him to investigate a curved tridimensional space, just as he investigates a homaloidal tridimensional space. But all the same, it is absurd to attempt the interpretation of the results without supposing that fourth dimension as the *conditio sine quâ non.*

Now we will suppose that the triangle in question has been surveyed, and that the sum of its three angles have been found to deviate from π far beyond the assigned limit of error: what have we really got thereby? The triangle, says Prof. Clifford, is formed by drawing "lines of shortest distance" between the three points in space. Is observation through a telescope drawing such a line? Be it so, for the sake of argument. Then, if the conclusion to be drawn is that space is curved, I ask does it or does it not follow that the sides of the triangle are themselves curved? Observe that if those seeming (to us) straight lines are really curves of an exceedingly small curvature, the Euclidian law is not touched. Of course, then, Prof. Clifford did not mean to assert that in a case in which the sides of a triangle are not absolutely straight lines, it does not necessarily follow that the sum of its angles is equal to π: for Euclid himself is quite ready to admit that. No: Prof. Clifford must have meant that those three sides, though *absolutely straight* to us, creatures who can only imagine a homaloidal tridimensional space, are curved in a sense (thanks to a fourth dimension) which vitiates the Euclidian law.

Of course he may disclaim this interpretation: or he may assert that in the case supposed the three sides are both straight and curved, or neither straight nor curved, if such be his view. But until I see his disclaimer I shall hold that he meant to suggest to his audience that straight lines (proved to be so by the standard of straightness which is alone imaginable by creatures constituted as we are) are in another sense really curved, and as such afford an observable exception to the Euclidian Law. Now I say that, constituted as we are, we could have seen straight lines only as straight, and therefore we simply *could not* see those sides otherwise than as verifying that Law; and so we could never bring to the test of observation the question raised by the great quaternion of geometers; and therefore must for ever remain in absolute ignorance whether the space, in which we "live and move and have our being," be (in another relation) something different from what we find it to be in relation to our faculties.

C. M. INGLEBY

Athenæum Club, Feb. 8

Earthquake in Pembrokeshire

I HAVE received a letter from the west part of Pembrokeshire, dated February 3, from which the following is an extract:—

"Last Saturday, at 7 A.M., my bed shook twice under me; and at the same time the servant went into the dining-room, the fire-irons rattled and the room shook; an hour later, ——'s bed shook twice."

I do not know whether any notice has been taken of the occurrence elsewhere. I have paid some attention of late years to the indications of earthquakes in this neighbourhood, and am inclined to think that slight tremulous movements take place more frequently than may have been supposed or recorded. They would naturally be unnoticed in the daytime, and their detection would depend upon accidental wakefulness at night.

Hardwick Vicarage, Feb. 8 T. W. WEBB

Meteorology of the Future

IT is with some satisfaction that I have read in NATURE of December 12, 1872, the very interesting paper of Mr. J. Norman Lockyer, entitled "Meteorology of the Future," giving adhesion and the support of his name to the discovery of Mr. C. Meldrum, of a cycle of 11 years in the recurrence of the maximum of cyclones and rainfall in the southern hemisphere; a cycle corresponding with that already recognised in the maximum of sun-spots. But I have been somewhat surprised to see that my name has not been mentioned by Mr. Lockyer in reference to Mr. Meldrum's paper, as I have also published a paper on the connection of sun-spots with rainfalls, storms, cyclones, &c., prior to the first paper of Mr. Meldrum, which appeared in NATURE, October 24, 1872. Thinking that my paper has escaped your notice, and trusting that you might have some interest to see it, I take the liberty to forward it to you with this same mail. It was published in the *Boston Daily Advertiser*, November 2, 1871. Over a year has elapsed since its publication, and few are the days on which I had no opportunity of seeing the sun and scrutinising its spots with especial care, with the aid of telescope and spectroscope; and to-day I do not see the necessity of changing a word of the conclusions which I had come to in that paper. Only it appears that, in addition to the laws which I have drawn out, the position of the moon will have to be taken in consideration as a complicating element; as it seems that the conjunction and opposition have a tendency to increase the influence of the spots on our atmosphere, while the quadrature diminishes it in a certain measure. I could make some other remarks taken from my greater experience on the subject, but they are of secondary importance, and I will wait for another opportunity to publish them.

Perhaps I did not guard myself sufficiently in my paper, and have not explained with a sufficient amount of clearness, that though the effect of sun-spots on the weather is general all over the globe, yet the result cannot be expected to be absolutely the same; as local causes, very numerous, like mountain chains, forests, rivers, coasts, oceans, and climates, have an independent influence on the distribution of rains and the direction of winds, &c. But local causes are of a secondary order, and will be easily determined when once we are sure that the primary cause of atmospheric disturbances is to be found in the solar spots

L. TROUVELOT

Cambridge, Mass., Jan. 27

Deep Wells

SINCE the question of the supply of water to deep wells was touched upon in NATURE (vol. vii. p. 177), in connection with the rainfall of 1872, I have been in hopes each week of seeing the subject thoroughly and scientifically discussed. It will be recollected that while we were all sneezing and spluttering, and thoughtlessly complaining of the long-continued wet, Mr. Bailey Denton deprecated the premature interference of the Archbishop of Canterbury with the rain, on the ground that the deep wells were not yet filled. This raised a great deal of discussion; people lost their tempers over the rain; and the country seemed to be divided into three bitterly hostile parties—the supporters, the opponents, and the suppliants of Providence. But still the geologists held aloof, and no one even answered the question, "What is a deep well?" but continued to talk as if wells were divided into two classes, deep and shallow, by a hard and fast line.

I therefore venture to hope that some geologist will take up the question in your columns, and give us a few facts instead of opinions. Meanwhile, I will state the case as it appears to me. With the exception of chalk and limestone formations, deep wells are, I believe, unknown in hills. In the side of a hill water comes naturally to the surface in a spring. Wells are only required—or, at all events, deep ones—at a distance from hills. They derive their water from water-bearing strata supplied in all cases either directly from hills, or indirectly from hills through the leakage of river-beds. No amount of rain falls upon cultivated, and therefore comparatively low-lying, land in Europe, sufficient to penetrate to even a shallow well through the earth immediately around it. This, at least, I presume to be the case, for 33 per cent. of their own bulk may be taken as an average amount of water for average soils to be able to retain and hold, so that if a well were 15 ft. deep to the top of the water it could not be affected by less than 5 ft. of rainfall, and when we deduct the enormous proportion of the 5 ft. that would be lost by evaporation and intercepted by vegetation, it is manifest that even 5 ft. of rain could not penetrate 15 ft. through any ordinary average soil. How, then, could any rainfall penetrate to a "deep" well of, say 100 or 200 ft. in depth?

Feb. 9 W. HOPE

THE GRESHAM LECTURES ON PHYSIC

THE Hilary Term Course of Lectures on Physic were delivered at the Gresham College, Basinghall Street, by Dr. Symes Thompson, on the evenings of the 17th and 18th ult., and the subject of the discourses upon this occasion was the important and interesting one of Contagious and Infectious Diseases. The professor started on his career of familiar explanation by describing two recent instances of outbreak of infectious disease in rural districts, in which the introduction and march of the fell agent of communication through the ranks of the small community could be distinctly traced. In the one case, the infection of scarlet fever was brought to the village of Flindon, in Hampshire, by a girl who came from Worthing, and served in a small general shop which was resorted to by all the villagers. Only two houses in the village that had children in them, escaped from the disease. In the other case, enteric fever was taken to Whitchurch, in Hampshire, by a young woman from Basingstoke, who returned to Basingstoke to die, after only six days' sojourn in Whitchurch. The fever, nevertheless, spread from the house in which she stayed, and within the next seven months there were seventy cases of enteric fever in a small community numbering only 1,450 people. The instance at Whitchurch acquired especial importance and interest, because it was made the ground for an investigation and report by the Local Government

Board, which now concerns itself with matters of this class. The inspector, Dr. Thorne, found that the place had been remarkably healthy until the potential cause, or infection, of the fever was conveyed to it by this chance visitant; but that it was most cunningly and elaborately prepared to receive and energise the deadly influence when once it came in the way. About one-third of the town stands upon the porous gravel of the alluvial bed of the river Test, and into this gravel, side by side, shallow wells were dug, to furnish the place with water, and pits were hollowed for the reception of all kinds of refuse filth and exuviæ incident to the conditions of life obtaining with a town community. Special care seems to have been taken to place the wells at a somewhat lower level than the pits containing the sources of pollution, whenever this was possible, as if to make sure that the liquid refuse should run into the reservoirs of the water; and in a few road-drains that had been laid down in the streets, commodious catch-pits were provided, to serve as traps and lurking-places for the offensive waste. Piggeries and small manure-yards were profusely scattered through the streets; and when once the enteric disorder had appeared, in order that it might have the fairest possible field for its operations, it became in some instances the practice to put sound people to bed with relatives actually suffering from the fever. In the case of Whitchurch, it amounts almost to a demonstration that the bowel discharges of the chance visitant from Basingstoke, containing the poison of enteric fever, must have been passed immediately into the water that was provided for the general service of the town; and that an exhaustless supply of the particular pabulum that is required for the elaboration of fresh quantities of the poison for the propagation of the malady, was kept ready on hand with the poison and the water. Enteric fever came by chance to the neighbourhood of Whitchurch; but, once there, it cannot be said that it made itself at home, and spread through the houses of the community by chance. The most elaborate provision had been made in the township to secure for it an easy resting-place, and a ready path of dissemination.

These cases of actual occurrence were happily selected by the Gresham Professor of Physic as the text of his discourse, because they aptly illustrate the value of the popularisation of information of this class, a result which it is the object of the Gresham College to insure. In the fever outbreak at Whitchurch, enlarged upon by Dr. Thompson, and from which something like every fourteenth member of the community was infected more or less gravely before the plague was stayed, nothing could be more clear than that the lodgment and seed-bed of the pestilence was prepared for it by human agency, but of course in entire ignorance of the dreadful work that was being performed. It is scarcely possible to believe that, if any single member of the constituted "nuisance authority" and "sewer authority" of Whitchurch had ever been present at the Gresham College when a lecture upon infectious and contagious disease had been delivered by the Gresham Professor of Physic in its theatre, there would have been an eight-months-long prevalence of enteric fever in the town.

The obvious, and indeed only certain, cure for evils of this character is the spread of sound information regarding matters that affect, and physically influence, health and disease, and the enlightenment of public opinion. The inhabitants of Whitchurch were the only people in this case who could possibly have been the efficient guardians of their own well-being.

Dr. Thompson designedly touched lightly upon the precise nature of the seed-germs of contagion; he satisfied himself upon this occasion by pressing home to the ordinary understanding, the great and incontrovertible fact, that diseases of this character, which sometimes decimate crowded co[illegible]d which at all times levy a heavy tax upon human vigour and life, are caused and spread by influences which are well known to human intelligence, and largely within the sphere of human governance and control. Each form of infectious fever has its own characteristic habit and idiosyncrasy. Enteric fever and cholera tend chiefly to disseminate themselves through water, passing into the wells and fountains of daily supply, and at times travelling from house to house in the milk-cans of the easy-conscienced dairyman. Scarlet fever hybernates in a drawer, and after long months of seclusion comes forth with some old and cast-aside garment to be thrown with it round the throat or head of some new victim, and so to start thence upon a fresh career. Typhus fever crawls sluggishly almost from hand to hand and mouth to mouth, and is immensely sociable and companionable in its spirit, languishing away when condemned to solitary confinement. Typhoid fever generates itself where filth, overcrowding, and impure habits of life prevail; and relapsing fever glides in the track of privation and misery. But the entire band of the ruthless co-fraternity agree in their subordination to known laws, and controllable conditions.

The beneficent influences and allies upon which human intelligence draws in dealing as efficiently and successfully as it now can with the work of controlling these evil ministrants, are, in the main, careful isolation of the sick; the preservation of the water from which daily supplies are derived in uncontaminated purity; the uninterrupted ventilation alike of hospitals and dwelling-houses, and fresh air; the immediate removal from the vicinity of active human life of all material contaminations that issue from the bodies of the sick, and the destruction of their morbific influence and energy by mixing them with antiseptic and disinfecting chemical agents such as carbolic acid, sulphuric acid, chlorides of lime and zinc, permanganate of potash, and charcoal; the preservation of the vital forces and resisting powers of the living frame by a well-ordered temperate rule of life, and avoidance of any undue indulgence in any kind of excess; and above all things the cultivation of an intelligent and ever enlarging familiarity with the great material conditions of nature that have been made the means of working out the marvellous arrangements and operations of civilised human life.

In considering the influence and powers of the various health-preserving chemical substances that are spoken of as antiseptics and disinfectants, it should be understood that agents of the character of carbolic acid, which are properly antiseptics, operate mainly by arresting the progress of fermentation and decomposition, while agents of the nature of Condy's fluid (permanganate of potash), chloride of lime, and especially charcoal, which are properly disinfectants, act by absorbing the noxious products of decomposition. Dr. Thompson very prettily illustrated this part of his subject by stopping the gradual evolution of bubbles of gas from a fermenting solution of sugar by adding to it a few drops of carbolic acid, and by showing that any drinking water that contains a hurtful trace of the rotten egg gas, sulphuretted hydrogen, immediately discharges the beautiful violet colour of Condy's disinfecting fluid. But his most telling illustration was the mortal remains of a defunct rat which he presented to his audience enshrined in a glass jar, and simply embalmed in charcoal. This rat was placed in the jar with the charcoal, at the termination of its natural life, some six or eight years ago; and from that time to this has been kept in the laboratory of Charing Cross Hospital for the greater part of the time with only a light paper cover over the jar. At the present time there remains of the rat's organism only the bones and a few hairs. But throughout the lengthened period of decomposition, no trace of disagreeable smell was at any time emitted. All gaseous products of decay were at once seized, and held by the charcoal.

THE BIRTH OF CHEMISTRY

VII.

Avicenna.—Albertus Magnus.—S. Thomas Aquinas.—Roger Bacon.—Raymond Lulli.—Arnoldus de Villâ Novâ.—George Ripley.—Basil Valentine.

THE Schools and Colleges of Arabia soon gave evidence of their value by the development of several considerable geniuses, whose works formed the text-books of Europe during a portion of the Middle Ages. Prominent amongst these learned Arabians was Ali-ben-Sina, or Avicenna, who was born in 980 in the neighbourhood of Shiraz. His abilities were considerable, and no pains were spared in his education; as a boy he read the Almagestum of Ptolemy, the Geometry of Euclid, and the Philosophy of Aristotle, and later in life he studied medicine with great success. We are told indeed that at the age of sixteen he was an eminent physician, and that at eighteen he cured a caliph of some grave disorder, and was hence promoted to great honour.

Avicenna is best known by his celebrated "Canons," which were translated at an early date into Latin, and often printed under the title of "Canones Medicinæ." This work has been translated into the languages of all civilised countries, and for no less than six centuries was the standard medical treatise of the world.

Avicenna also wrote on Alchemy and on Chemistry. If the works attributed to him are genuine he appears to have adopted the Aristotelian theory of the four mutually convertible elements. He speaks of air as the aliment of fire, and of the metals as compounds of a humid substance and an earthy substance. This last idea evidently arose from the observation of the calcination of metals. It was well known that if certain metals, such as lead and tin, are heated for a length of time in the air they are converted into a powdery substance or calx, and it was long before it was proved that this calx is not the metal from which one of its constituents has been expelled by fire; but, on the other hand, the metal combined with another substance. Avicenna divides all minerals into four classes; viz., (1) Infusible minerals; (2) Minerals which are fusible and malleable, that is, metals; (3) Sulphurous minerals; and (4) Salts. He noticed that mercury can, by heat, be caused to unite with sulphur and produce a solid body, having different properties from its constituents.

Avicenna was largely indebted for his knowledge to Alfarabi and to Rhazes. The latter wrote on medicine, and was one of the first to introduce substances formed artificially by chemical means into medicine.

Turning now our attention to European alchemists we meet at the outset with the name of Albertus Magnus (b. 1193, d. 1282), who became Bishop of Ratisbon in 1259. Various works on Alchemy are attributed to him: he wrote on the philosopher's stone, on the origin of metals, and on minerals; and he has described at some length various chemical operations, such as sublimation and distillation, and various forms of apparatus, such as aludels, alembics, and water-baths. He followed Geber in the belief that metals are composed of sulphur and mercury, and that different metals are produced by different combinations, and to some extent by the variations in the purity, of these substances. Albertus Magnus employs the term *affinity* (*affinitas*) to designate the cause of the combination of sulphur with silver and other metals; in this precise sense, applied to all cases of chemical combination, the term is used in the present day. He also speaks of sulphate of iron as *vitriol*, a name which it long retained. He describes the preparation of nitric acid, its principal effects upon certain metals, and its utility for separating silver from gold, inasmuch as it will dissolve the former and not the latter. Cinnabar, or sulphide of mercury, had long been known and used as a source of mercury; Albertus proved that it consists of sulphur and mercury by preparing it artificially, by subliming sulphur with mercury.

Albertus was not alone learned in Alchemy; he was a profound theologian, a scholar, an astronomer, a physician, and some said an adept in magic and necromancy. He embodied his wisdom in twenty-one folios, which were published in a collected form in 1651. M. Lenglet Dufresnoy, in his "Histoire de la Philosophie Hermetique," has mentioned several magical operations gravely attributed to Albertus Magnus by various writers. The most noticeable piece of magic was the sudden transformation of a winter's day into glowing summer:—"Horridam hyemem," says Trithemius, "in florigeram fructiferamque vertit." It is said that once during a very severe winter, he invited Count William of Holland, when he was passing through Cologne, to a feast. The Count, on his arrival with a considerable retinue, was surprised to find the feast spread in the garden, in which there were several feet of snow; and this treatment so angered him that he remounted his horse and prepared at once to leave his inhospitable host.

> Then the monk falling on his knees besought
> The Count to sit one moment at the board.
> He having done so, a most wondrous change
> Passed on the instant over all around.
> The dark clouds floated off, and left a sky
> Intensely blue, an air exceeding clear;
> The sun shone brightly, and the warm south wind
> Laved their pale cheeks and warmed them into life.
> They sit on greenest grass, the snow is gone,
> Sweet flowers bloom beneath their very feet,
> Ripe peaches blush upon the garden wall,
> And orange blossoms scent the humid air.
> A swarm of insect life on droning wing
> Is floating up above them in the breeze.
> The voice of birds is heard; the cooing dove
> Speaks softly to her mate; the nightingale
> Trills a sweet lay, half hidden in the leaves.
> All nature is most joyous in her garb
> Of brightest summer day, and all things seem
> To glory in the flood of warmth and light.

Upon this, the Count expressed considerable astonishment, as although he had heard a good deal of the magical powers of his host, he was quite unprepared to find him capable of changing the seasons. As soon as the feast was ended, Albertus Magnus repeated a magical formula—

> Now snow obscures the air, the flowers fade.
> The trees are torn by pitiless strong winds
> And weep their shrivelled fruit upon the earth;
> All sound of life is gone, a roar of elements
> Succeeds the plaintive quavering of the leaves.
> The birds fall dead to earth, and the dark air
> Betokens fearful tempests yet to come.

So the Count and his retinue rush off into the house to warm themselves, and thus ends the feast of Albertus Magnus. Some will have it that the story alludes to a winter garden, unknown at that time, which had been devised by Albertus for the preservation of rare plants. Middle Age books on science abound with such stories, and the belief in them was almost universal, as it well might be in an age in which the power of witches and wizards was acknowledged, and the raising of the dead was an admitted possibility. Brücker (*Institutiones Historiæ Philosophicæ*) says:—"Quæ enim de ejus convivio magico narrantur, merito inter inficeti seculi fabulas referuntur, quæ ex ignorantia rerum naturalium, eo tempore crassissima et Alberti mirabili rerum physicarum cognitione prodierunt."

In the church of S. Andreas in Cologne they show to this day the shrine and relics of Albertus—the accomplished churchman, scholar, magician and alchemist, of whom Trithemius says, "Magnus in Magia Naturali, major in Philosophia, maximus in Theologia."

Albertus had for his pupil the "angelic doctor," S. Thomas Aquinas (b. 1225, d. 1274), who was a great alchemist, and who wrote a treatise called "The most secret Treasure of Alchemy," together with some other works on the subject, which are equally obscure and unintelligible. He wrote also on the artificial preparation of gems, by fusing glass with certain substances, like oxide of copper, to communicate different colours; he mentions that if copper be heated with white arsenic, the former becomes white, something like silver. According to some, S. Thomas Aquinas was the first to employ the term *amalgam*, to designate a compound of any metal with mercury. S. Thomas was, like his master, a magician. We are told that between them they constructed a brazen statue, which Albertus animated with his *elixir vitæ*. It was useful as a domestic servant, but very talkative and noisy; nor could they cure it of this propensity. It happened one day that S. Thomas, who was a mathematician, was deeply engaged in a problem, but was continually interrupted by the talking statue; at length in a rage he seized a hammer and smashed it to atoms, to the great regret of his master.

Our great countryman Roger Bacon (b. 1214) also suffered from a charge of magic, and during his residence in Oxford was severely persecuted in consequence. He replied to the charges made against him by the admirable treatise "De nullitate magiæ," and in it clearly showed that what his contemporaries mistook for the work of spirits, were in good sooth the ordinary operations of Nature. In this work he speaks of gunpowder, although somewhat obscurely. "Mix," says he, "together saltpetre, *luru vopo vir* *con utriet*, and sulphur, and you can make thunder and lightning, if you know the method of mixing them." Elsewhere he says, "a small quantity of matter properly manufactured, and not larger than one's thumb, may be made to produce a horrible noise and sudden flash of light." The third constituent of gunpowder is designated under the anagram *luru vopo vir con utriet*, for it was dangerous in those days to speak too plainly; indeed Bacon tells us that he adopted an obscure style both on account of the example of other writers, and of propriety, and also on account of the dangers of plain speaking. According to some writers, the following passage is to be found in Bacon's writings:—"Sed tamen salis petræ, *luru mone cap ubre*, et sulphuris, et sic facies tonitrum si scias artificium." Thus the saltpetre and the sulphur are directly designated, while the anagram *luru mone cap ubre* is convertible into *carbonum pulvere*, the remaining constituent—powdered charcoal. It is improbable that Roger Bacon invented gunpowder, although he was the first to know of its properties in England; he probably procured the knowledge from an Arabic source. Gunpowder was first used by the English at the battle of Crecy in 1346, 61 years after the death of Bacon; at this time it was apparently unknown to other European nations.

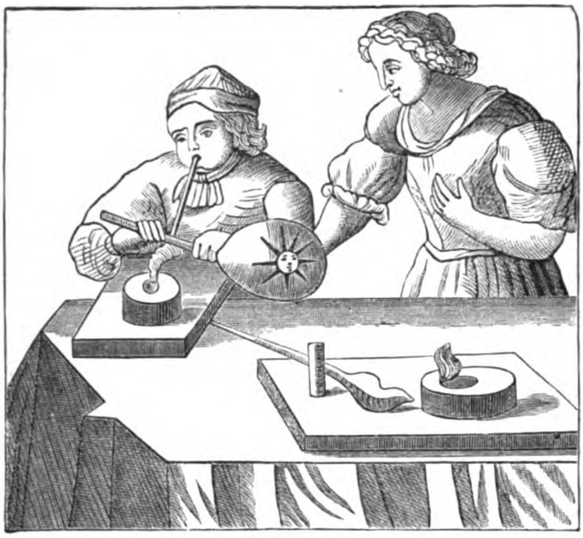

FIG. 11.—An alchemist hermetically sealing a flask containing a solution of gold.

Roger Bacon is believed to have been far in advance of his times in all matters of science. To him has been attributed the invention of the telescope and *Camera obscura*, and several discoveries of a later date. The evidence is less conclusive than one could wish, but enough remains in his writings to prove that he was a very learned man and profound thinker. His "Opus Majus" clearly proves that he fully recognised the value of the experimental method, and of the inductive philosophy afterwards so ably advocated by his namesake Francis Bacon. Roger Bacon wrote largely on alchemy. Many of the alchemical MSS. in the British Museum are transcripts of portions of his works, among the more celebrated of which we may mention the "Medulla Alchymiæ," "Secretum Secretorum," and "Speculum Secretorum." He collected together the principal alchemical facts of his predecessors, and appears in many matters to have closely followed Geber. Bacon describes the distillation of organic substances, and alludes to the inflammability of the evolved gases. He proved that air is the food of fire by burning a lamp in a closed vessel.

Raymond Lulli (b. 1235) is by some asserted to have been a pupil of Roger Bacon. He was a voluminous writer on alchemy, his most celebrated treatise being his "Ultimum Testamentum." He also wrote on transmutation, on the Philosopher's Stone, and on magic. Lulli does not appear to have added to the chemical knowledge of his predecessors; he followed Geber closely, and was well acquainted with the processes and compounds which he describes. He describes alcohol under the names of *aqua vitæ ardens*, and *argentum vivum vegetabile*, and was in the habit of rendering it anhydrous by allowing it to stand in contact with dry carbonate of potassium. He was also acquainted with ammonia.

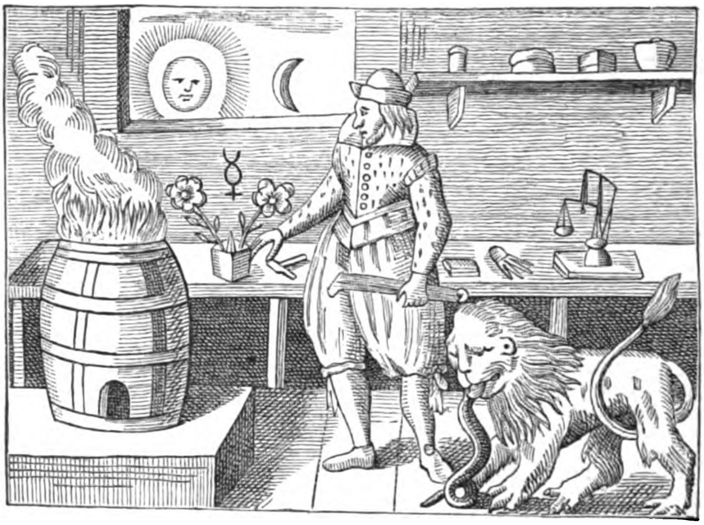

FIG. 12.—Alchemical representation of processes.

Whatever Lulli's knowledge may have been, he obtained great reputation as a successful alchemist. He asserts in his "Ultimum Testamentum" that he converted fifty thousand pounds weight of base metals into gold. He is said to have been employed by one of the Edwards to make gold, and to have furnished His Majesty with six millions of money. Dickenson tells us that Lulli had a laboratory in Westminster Abbey, in which, after his departure, a quantity of gold dust was found.

Of the general tone and character of alchemical writings we shall speak more fully in the next article. Of the professors of the art little more need be said; a long list of names might be given, but it would be found that they did little to develop what afterwards became the science of chemistry. Let us glance at the work of a few of the remaining alchemists. Arnoldus de Villâ Novâ (b. 1240) was a great alchemist and physician, and the author of many works on the subject. His "Rosarius Philosophorum" purported to contain a key to all alchemical operations. He followed Geber closely. He considered a solution of gold the most perfect medicine, and we usually find that such solution was recommended by alchemists as a necessary constituent of the elixir vitæ, and essential for the work of transmutation. In Fig. 11 the solution of gold in the flask is represented by the sun emitting rays. The simple disc of the sun is the more common symbol for gold.

Arnoldus also distilled various oils and essences. He contended that sulphur, arsenic, mercury, and sal ammoniac—all volatile bodies be it noted—are the souls of metals, and are given off during calcination. He also affirmed that silver is intermediate between mercury and other metals, just as the soul is intermediate between the spirit and the body. Arnoldus is said to have had for his pupil Pope John XXII., an accomplished alchemist, who left at his death eighteen millions of florins, which the alchemists fondly cite as a proof of the possibility of transmutation. Our own George Ripley, Canon of Bridlington in Yorkshire (b. about 1460) wrote a poem on alchemy, and passed for a successful disciple of the art, but we cannot point to a new fact which he elucidated. He divided all chemical operations into twelve processes—Calcination, dissolution, separation, conjunction, putrefaction, congelation, cibation, sublimation, fermentation, exaltation, multiplication, and projection. Several MS. copies of his poem exist in the British Museum, bound up with copies of the works of Roger Bacon and earlier writers. Here is a specimen of his rugged rhymes:—

> The fyrst chapter shall be of naturall *Calcination* ;
> The second of *Dyssolution*, secret and phylosophycall :
> The third of our elementall *Separation* ;
> The fourth of *Conjunction* matrimoniall ;
> The fysth of *Putrefaction* then followe shall :
> Of *Congelation Albyficative* shall be the sixt,
> Then of *Cybation*, the seaventh shall follow next.

One of the most celebrated of the alchemists was Basil Valentine, who was born at Erfurt in 1394. According to Olaus Borrichius his works were accidentally discovered in the wall of a church at Erfurt many years after his death. A thunderbolt struck the church and exposed to view the long-lost alchemistical treasures. Basil Valentine was the author of many treatises, the most important being his "Currus Triumphalis Antimonii," in which he discusses the properties of antimony and of many of its compounds. He regarded the metals as compounds of salt, sulphur, and mercury; and he was acquainted with many metallic compounds, among others nitrate of mercury, sulphide of arsenic, red oxide of mercury, chloride of iron, sulphate of iron, fulminating gold, carbonate of lead, acetate of lead, and the oxides of lead. He was aware that iron precipitates copper from solution, and that solution of potash precipitates iron from solution. He was well acquainted with the preparation of nitric and sulphuric acids, and used them for various purposes of dissolution. In order to obtain nitric acid he distilled powdered earthenware with nitre, or equal parts of nitre and green vitriol, or nitre with finely powdered flints. He obtained fuming sulphuric acid by distilling green vitriol, after the manner still practiced at Nordhousen and elsewhere. Basil Valentine wrote very obscurely and was fond of symbolical designs. Woodcuts 12 and 13 are taken from his works, and represent various processes imperfectly described. Thus the lion in Fig. 12 would represent a solution of a metal, the serpent another solution, or perhaps the serpent a metal, and the lion devouring it a solvent; the sun and moon are watching the operation, and the symbol of mercury appears between two roses. Fig. 13 represents some operation which is thus thus described by the principal figure:—I am an old, infirm, debilitated man, my soul and spirit (represented by the two boy-headed birds above his head) leave me, and I assimulate the black crow. In my body are found salt, sulphur, and mercury. This may possibly refer to the solution of gold in aqua regia: it loses its metallic nature, its solidity and lustre, and assimulates the acid; but one may conjecture in vain concerning the enigmatical devices in which some of the alchemists took so much delight, and which they often employed, like Roger Bacon's anagram, to conceal the full significance of their operations or discoveries.

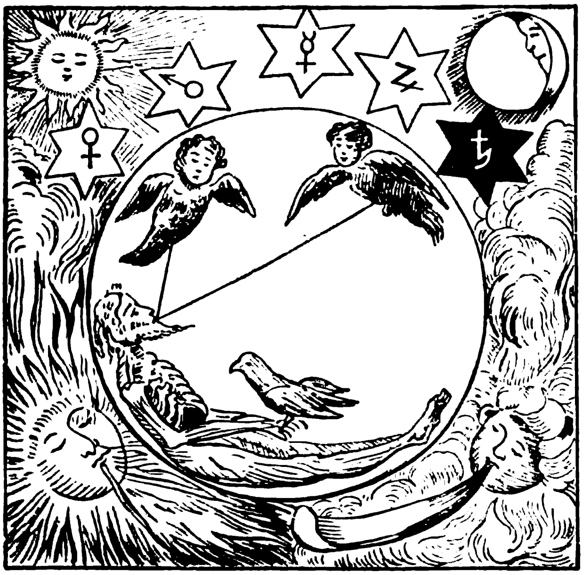

FIG. 13.—Alchemical representation of processes.

The following extract, in which he treats of the generation of metals, will show the style of Basil Valentine's writing:—

"Therefore think most diligently about this; often bear in mind, observe, and comprehend that all minerals and metals together in the same time, and after the same fashion, and of one and the same principal matter are produced and generated. That matter is no other than a mere vapour, which is extracted from the elementary earth by the superior stars or by a sidereal distillation of the macrocosm, which sidereal hot infusion, with an airy sulphureous property, descending upon inferiors, so acts and operates, as in those metals and minerals is implanted spiritually and invisibly a certain power and virtue, which fume afterwards resolves in the earth into a certain water, from which mineral water all metals are thenceforth generated and ripened to their perfection, and thence proceeds this or that metal or mineral according as one of the three principles acquires dominion, and they have much or little of sulphur and salt, or an unequal mixture of them; whence some metals are fixed, that is constant or stable; some volatile and easily mutable, as is seen in gold, silver, copper, iron, lead, and tin."

Now this is by no mean the most obscure piece of alchemical writings with which we shall come in contact.

G. F. RODWELL

GLACIER MOTION

IN making some experiments on the freezing of water some time ago it was noticed that after the same water had been melted and frozen a number of times it generally burst the tube in which it was frozen. On looking for an explanation of this phenomenon, it became at once evident that the experiment contained the germ of the explanation of glacier motion. Every time the water was frozen in the tube there was a mimic representation of glacier motion. The ice possessed, the first two or three times it was frozen, a certain amount of viscosity which enabled it to adapt itself to the shape of the tube, as was evident from the distortion of the upper surface of the ice in the tube. How came the ice to lose this plasticity or viscosity, this power of adapting itself to the shape of the tube, the loss of which caused it to burst the tube after it had been frozen and melted a number of times? Wherein did the ice which had only been frozen once differ from the other? The answer to this seemed to be, that the ice which had only been frozen once had more air in it than that which had been frozen and melted a number of times, as each succeeding freezing deprived the ice of a quantity of air or some other gases. The natural conclusion, therefore, seemed to be, that ice with air in it is a viscous substance, though pure ice is not. The first question then to be asked is, Is ice with air in it a viscous substance? In order to get an answer to this question, glass tubes ·4-inch in diameter and twelve inches long were filled with water in which was dissolved a great quantity of air. The tubes were then placed in a freezing mixture. After the water was frozen in the tubes the tubes were slightly heated and the rods of ice withdrawn from them and placed on two supports eight and a half inches apart, and a weight of one pound hung from the centre of these ice beams. The beams at once began bending and continued bending so long as the weights were left on them, thus proving the viscosity of the ice experimented on. The ice of these beams though similar was not the same as glacier ice; other ice beams were therefore made, in as close imitation of glacier ice as possible, which was done by placing a small quantity of water in the tubes, then some snow, and pressing it firmly to the bottom of the tubes, then adding more snow, and again firmly pressing it down, and so on till the tubes were filled, as much pressure being applied as possible to the snow to drive out the water. The tubes were then placed for some time in the freezing mixture. The ice beams were afterwards withdrawn from the tubes and placed on the supports, and a weight of one pound hung from the centre. The beams of snow ice so made were found to be more easily bent than those made from the water. The rate at which they bent varied, possibly owing to there being more or less water-ice mixed with the snow-ice: one of the beams bent one inch in five minutes. Temperature seemed to have some influence on the rate of bending of these beams, but this point was difficult to determine on account of the different beams bending at different rates at the same temperature; but so far as could be ascertained from the experiments, the beams bent slower the lower the temperature. The lowest temperature used in these experiments was rather more than three Fahrenheit degrees below freezing.

Smaller rods of snow-ice were then made ·2-inch in diameter, and as it was found that these could be easily bent in the hand, it was thought possible to bend them into rings. In attempting to bend these rods round a cylinder three inches in diameter, a difficulty was met with. After the pressure had been applied a short time, and before the circle was half turned, the rods always broke with a pressure which they easily bore at the beginning. Here, then, was a difficulty. The explanation seemed to fail at the last moment. The bending had so altered the structure of the ice, that it had lost much of its viscosity and become brittle. How then are we to account for glacier ice keeping its viscosity after years of bending. On examining the fracture of the beams it appeared as if a fibrous structure had been developed in the ice by the bending. The fracture did not go straight across, but part of it ran parallel with the axis of the beam, strongly resembling the fracture of poor bar iron, crystalline at one part, fibrous at another. The bending of the ice had evidently developed a laminated structure in it, similar to that found in glaciers. This laminated structure was developed along the beams, as was to be expected; for the direction in which this structure will be developed depends more on the direction in which the particles of ice are caused to slip over each other, than on the direction in which the pressure or tension is applied. The bending having produced this laminated structure in the ice, it is evident that the beams will be weaker after this structure is developed than before, on account of the cohesion of the ice being weakened along the planes of lamination. It was thought therefore that if the pressure was taken off the ice so as to relieve the particles from strain and stop them sliding over each other, that the laminæ which had been developed in the ice, would, so to speak, become welded together, and the strength and plasticity of the beam be restored. Acting on this supposition an attempt was again made to bend the ice-beam into a circle. After a small part of the circle had been turned, the pressure was taken off the beam and a short time given for the particles to rearrange themselves; the pressure was then again applied, a small part more bent and so on. When done in this way it was found that the ice-beams were easily bent into a circle, the ends were then united by means of pressure, and a solid ring was thus produced from a straight beam of ice. These conditions of alternate rest and pressure are in all probability those which exist in glaciers. After pressure has acted at one part of the glacier, bending takes place, so relieving the ice at that part from the pressure, which comes to bear on another part of the glacier; and before the pressure again comes to bear on the first part its strength and plasticity or viscosity has been restored by rest.

Although ice under certain conditions has by these experiments been shown to be a viscous substance, to have the power of changing its shape and so enabling it to flow—though slowly—in its channel; although it has thus been shown that the viscosity of ice is a cause of glacier motion, yet it must not, therefore, be concluded that it is the only cause. Among other causes which may assist in producing glacier motion may be mentioned: 1st. The sliding of the ice over its channel; this sliding being assisted by the tendency which the ice has to melt where it rests on its channel. 2nd. The melting of the ice in front of obstacles, the melting being produced by the melting point of the ice in contact with the obstacle being lowered by the pressure of the ice behind. 3rd. The melting of the ice in the body of the glacier, by heavy pressure being brought to bear at certain points, part of the water so formed finding its way to the channel under the ice, and part being re-frozen. 4th. The crevasses in the glacier formed by the fracture of the ice. This breaking up of the ice will enable large masses of ice to move into different positions relatively to each other, much more easily than if the ice was solid. This breaking up of the ice will also make the motion due to its viscosity take place quicker than if the ice was in one mass. 5th. The old dilatation theory explains something of the motion of glaciers, though it may not explain how that motion takes place, yet it accounts for some of the pressure which produces that motion.

JOHN AITKEN

SUB-WEALDEN EXPLORATION

SINCE the last quarterly report, troublesome accidents have delayed this undertaking. On the very day of the meeting in Jermyn Street in December last, the drilling tool broke off close to the edge, leaving a flat chisel (9 in. wide tapering up to 2 in.) at the bottom of the bore. A fortnight was lost in the endeavour to extract it. Mr. Bosworth's ingenuity and patience were sorely tried; but he at last succeeded in bringing it to the top from a depth of about 96 ft. 34 ft. consisting of narrow bands of calcareous shale, alternating with argillaceous limestone in layers of from 4 to 6 in. were passed through; but on January 28, at 131 ft. from the surface, a bed of pure solid white gypsum 4 ft. in thickness, was reached and perforated, the new trifid drilling tool bringing up solid cores. This is the first time a bed of gypsum of this character has been found in Sussex, and it probably indicates the presence of the Purbeck beds. If so, strata hitherto unknown to exist in Sussex are now added to our geological information, and the scientific world will have its interest re-awakened to this, the first boring attempted in England for purely scientific purposes. Boring is a tedious and expensive process, and we hear that the preliminary cost of machinery has exhausted the treasury. Subscriptions are earnestly requested to complete the second sum of 1000*l*. promised on condition that 2000*l*. be raised. Mr. Henry Willett, Arnold House, Brighton, will be pleased to receive any sums for the purpose. It would be a great disaster indeed if the boring had to be stopped for want of funds; but we feel sure that when the state of matters is made known to the friends of science Mr. Willett will soon have to report a full treasury.

NOTES

The candidates for the chair of Geology held by the late Prof. Sedgwick now stand 'as follows:—Mr. Morris, Lecturer on Geology at University College, London, and a Vice-President of the Geological Society; Mr. P. Martin Duncan, F.R.S., also a Vice-President of the Geological Society, Professor of Geology in King's College, London, and Lecturer at the Indian College of Civil Engineering at Cooper's Hill; the Rev. Osmond Fisher, formerly Fellow and Tutor of Jesus College, Cambridge; the Rev. T. G. Bonney, Fellow and Tutor of St. John's College, Cambridge; Mr. Boyd Dawkins, F.R.S., formerly on the Geological Survey, and now Director of the Museum and Lecturer in Geology at Owens College, Manchester; Mr. A. H. Green, of the Geological Survey, formerly Fellow of Gonvillle and Caius College, and now Lecturer in Geology at the School of Military Engineering at Chatham; and Mr. Hughes, of Trinity College, also on the Geological Survey. Mr. Morris has acted for the last two years as deputy to the late professor.

A Correspondent in Paris informs us that M. Janssen was to be nominated to a vacant place in the French Institute last Monday, and that there is every likelihood of his obtaining a majority of votes when the election takes place a few weeks hence. M. Janssen is to be sent to Pekin in December 1874, for the purpose of observing the transit of Venus.

Probably the first telegram transmitted by the Atlantic cable, under the generous arrangement mentioned in Nature of January 30 last, was received by the Astronomer Royal on February 7, and forwarded to us the same day. It announced the discovery of a new planet, No. 129, of the 10th magnitude, on the night of February 6: R.A. $9^h 16^m$ north decl. 15° 38′. Such an excellent arrangement is likely to save all disputes as to priority of discovery.

Prof. Flower's Hunterian Lectures at the College of Surgeons for this year will treat of the Osteology and Dentition of Extinct Mammalia, with their geological and geographical distribution and relation to existing forms. The course commences on Monday next (the 17th) at four o'clock, and the lectures will be continued at the same hour on Mondays, Wednesdays, and Fridays until March 28. It may not be generally known that this course is open to all who wish to attend, without fee or any formality.

Dr. T. R. Lewis has made the important discovery of a haematozoon, which he has provisionally named *Filaria sanguinis hominis*. In a paper lately published at Calcutta, he describes its discovery last July in the blood of a patient suffering from a disease well known in tropical countries, Chyluria. The worms appear to be present in very large numbers in the blood and in some of the secretions; indeed, they were first observed in the urine two years ago. They are evidently hematoids, but sexual distinctions have not been hitherto observed, nor is anything known of their ova or development, nor how they gain an entrance to the body. Each is inclosed in a hyaline sheath, in which it can contract and expand itself, so that they may be probably regarded as in an encysted form. The average length is ·175 of an inch, the breadth about that of a red blood-disc; they are therefore much smaller than the Guinea-worm or *Trichina spiralis*. The disease of which it is probable that they are the cause is not rare in tropical countries, and is sometimes fatal. This curious "Filaria" was discovered independently in chylous urine, by Dr. Lewis and by Wucherer, in 1870. Dr. Crevaux, of the French navy, published a memoir on the same subject a few months ago ("De l'Hematurie chyleuse ou graisseuse des pays chauds;" A. Delahaye, Paris, 1872). In the Montpellier *Revue des Sciences Naturelles*, for September, 1872, Dr. A. Corre figures and describes some specimens as transparent, colourless, and varying in size from ·2 to ·265 of a millimetre long, by ·006 to ·007 broad at the thickest part. This exactly corresponds with the diameter of a human red blood-disc, as given by Welker. He has sometimes observed a slight constriction below the head, as has Dr. Crevaux, who also noticed the dark spot supposed by Dr. Lewis to be a mouth, "qui ressemble plutôt à un amas de granulations qu'à un orifice." MM. Crevaux and Corre have been unable to distinguish any organs, only granulations forming a central line down the body, "qui simule, au premier aspect, un canal étendu de la tête à la queue." Wucherer regards the worm as probably a larval form. It is important to remark that the cases examined by their authors were all from tropical America. The descriptions and the drawing referred to abundantly confirm Dr. Lewis's admirable observations, though they are not nearly so complete. To him belongs the undivided merit of discovering this parasite in its true *habitat*, the living blood.

The Director of the Observatory of Harvard College purposes to publish a series of astronomical engravings, which shall represent, as nearly as possible, the most interesting objects in the heavens, as they are seen with the powerful instruments of the observatory under his charge. The series will consist of at least thirty pictures, and will embrace the principal planets, moon-craters, sun-spots, solar prominences, nebulæ, and spectra of variable stars. To obtain some assistance towards defraying the expense of printing, as well as to secure for them a more general circulation than can be expected for volumes of annals of an observatory, they will be offered to subscribers at the rate of 2*l*. 10*s*. for the set. The engravings will be delivered from time to time as they are completed, and they will be followed by some pages of notes and explanations. Messrs. Trübner and Co. are instructed to register the names of intending subscribers.

The American Government has established an Observatory at Fort Garry, Manitoba, which is, as nearly as possible, the central spot of the American continent.

Ammonites have been discovered by Dr. Waagen ("Memoirs of the Geological Survey of India, IX.") in a carboniferous formation near Jabi, north of Shabpoor, in the N.E. of the Punjab. The form appears to be allied to some species found in the Whitby lias. The presence of this family in palæozoic rocks is a new and important observation.

South African sportsmen have got a bad name among many people, the increasing scarcity of the various kinds of so-called "big game" being commonly attributed to their exploits. There are those, however, who think otherwise, and believe, as is doubtless the case, that the deeds of an occasional Gordon Cumming, who makes a shooting excursion up the country, had little lasting effect upon its animal and particularly its mammalian life, the decrease in which is mainly caused by the spread of settlements. The University of Cambridge seems to be of the latter opinion, and on Thursday last, by grace of the Senate, authorised the payment, from the Worts' Travelling Bachelors' Fund, of 200*l*. to Mr. T. E. Buckley, F.Z.S. and B.A. of Trinity College, who is about to make an expedition into the interior from Natal, for the purpose of forming natural history collections, and especially of obtaining skeletons of the larger animals, with the understanding that specimens be sent to the Museum of the University, accompanied by reports. Mr. Buckley has had much experience as a traveller, having visited some of the wildest parts of Lapland, explored Turkey, and braved the dangers of the Gold Coast: and he has contributed, in conjunction with his fellow-voyagers Captain Elwes and Captain Shelley, to the *Ibis*, good accounts of the ornithology of the two countries last mentioned.

A severe shock of earthquake was felt at Lahore on January 1, at 7.55 A.M. and at Suchin on December 31. The earthquake, which on December 15 was felt at Lehree in Eastern Cachi and Zehri and the Scinde frontier of India, was also felt at Dadur, Suhwan, Shikarpore, and Jacobabad, within British territory.

In the beginning of January a sharp shock of earthquake was felt in the island of Imbros, opposite the Dardanelles. Several small works were destroyed, and other damage done. This was, perhaps the same as the earthquake felt on January 13 at Gallipoli, and Chanak, Kalebsi (Dardanelles), at about 10.30 A.M. The oscillation was from S. to N. This earthquake was slightly felt at Constantinople, but not at Smyrna.

The Royal Commission on Scientific Instruction met on Tuesday and Wednesday of the present week.

We learn, from the *British Medical Journal*, that Dr. Struthers, Professor of Anatomy at Aberdeen, gives free evening lectures on this subject to students of Divinity and Arts, and to all who take an interest in Natural science.

We have received an "Extract from the Science Directory, revised to November 1872," showing the nature and amount of assistance afforded by and through the Science and Art Department to Instruction in Science. This gives all the information needed both by pupils or teachers who are desirous of qualifying themselves to participate in the various grants, scholarships, exhibitions, prizes, &c., by which Government seeks to encourage scientific education. Since the publication of the last directory, several alterations have been made in the administration of this department. One is that grants are given to encourage the construction of special laboratories in Schools, and collections of apparatus adapted to teaching will be sent on loan to schools under certain conditions. For the year 1873 arrangements will probably be made to enable a certain number of teachers to stay about six weeks in London, to undergo a course of instruction in teaching certain special subjects. Several improvements have also been made in the course of instruction for students who have completed their course at the ordinary Elementary School. These alterations all tend in the direction of greater stringency and thoroughness, and an attempt has been made so to frame the course, as to lay the foundation of a systematic scientific training.

We with pleasure notice that a new local scientific society has been started at Kensington, under the title of the Kensington Entomological Society. There are now a considerable number of similar societies in the London suburbs, and we hope this one will meet with encouraging success, and produce some work of lasting value. We hope next week to give a paper read to the Society by Mr. A. Murray, 67, Bedford Gardens, Kensington, who, we have no doubt, will be glad to furnish information to anyone desirous of joining the Society.

We are glad to see one more provincial paper devote some of its space to Science. A copy of the *Leighton Buzzard Observer* sent us devotes a whole column to scientific jottings, selected with considerable judiciousness.

Mr. G. St. Clair, in reference to his letter of last week, sends us a letter from the *Manchester Guardian*, of February 5, which says that the writer and two friends were walking down Oxford Street, Manchester, about 10 P.M., when suddenly the place was illuminated with a bluish light equal to the light of mid-day, and right over their heads burst, as it were, a ball of fire; instantly it shot through space, when it burst again, and finally disappeared. After a few seconds more they distinctly heard the sound of a report like thunder. The course of the meteor appeared to them to be from east to west; the time was about seven seconds.

A Medical Society has been formed at Smyrna, on the basis of the Imperial Medical Society at Constantinople.

The Abbé Moigno, after all, has brought his *Salles du Progrès* to a termination; not, however, we are glad to learn, because his praiseworthy scheme of popular education has turned out a failure, but because he has found another means of accomplishing his "great object of intellectual regeneration by true science, good and beautiful." The founders of the Catholic Circle of Workmen—a scheme apparently meant for the elevation of the French working classes—have proposed to make use of the Abbé's services, his educational staff and *matériel*, to carry out their educational plans both in Paris and in the provinces. He has, we think wisely, accepted the offer, and, although he has been compelled to terminate his own particular scheme, he will be in a much better position for accomplishing the admirable end he has in view.

Mr. W. B. Gamlen, M.A., of Exeter College, has been elected Secretary to the Curators of the Oxford University Chest.

The following information has been sent us by the scientific editor of *Harper's Weekly*:—Prof. Powell has returned from the exploration of the Colorado River of the West, having completed the examinations of the wonderful series of cañons along the course of this river about October 1 last. He then visited a group of volcanic mountains north of the Grand Cañon, composed of about sixty basaltic cones, to which he has given the name of Uinkaret Mountains (the Indian name, signifying "Where the pines grow"). An extensive series of faults has been examined by the party this year. These run in a northerly and southerly direction across the Grand Cañon, and north into the plateaus at the head of the Sevier, and some as far as the Wasatch Mountains. They are from 50 to 200 miles in length, and the drop from 100 to 3,000 ft. The fissures of these faults have been vents for volcanic eruptions, and along their courses vast floods of lava have been poured out and cones built up. A number more of the ruins of ancient communal houses have been discovered, making in all more than a hundred so far found by the party in the valley of the Colorado. One of these was situated on the crater of a volcanic cone. The collection of picture-writings (etchings on the rocks) has been much enlarged; and the seven ancient towns, called by the Spaniards the Province of Tusayan, have been revisited for ethnological purposes. The professor has also continued his studies of the Ute Indians. He has discovered among them an extensive system of mythology and a great number of rude songs, and brought with him a large collection of articles illustrating the state of the arts among the people who inhabit the valley of the Colorado, composed of stone implements, pottery, basket-ware, clothing, implements for hunting and entrapping animals, musical instruments, ornaments of feathers, bones, teeth, and claws, and various miscellaneous articles. Prof. Thompson remains in the field for the purpose of extending the exploration north, toward the Wasatch Mountains.

An article by Herr von der Wengen, on the artificial breeding of salmon in Silesia during the season of 1871 and 1872, published in the circular of the *Deutsche Fischerei-Verein*, contains some very interesting facts in reference to this fish. As the result of four successive years of observation, he remarks that he finds salmon generally descend to the sea in the second year, and remain there not one year, as is so generally assumed, but more nearly two, before returning to the river and home of their youth. The establishment at Hammel, which has already done so much to increase the stock of salmon in the Upper Weser, has determined, from numerous observations, that a period of four years elapses between the birth of the salmon and its first return from the ocean.

OSCAR GRIMM describes Bacteria and Vibriones from his own investigations in the *Archiv fur Mikrosc. Anatomie.* He has observed their conjugation and fissiparous multiplication, and also has seen leucocytes breaking up into granular matter which ultimately assumed the form of Bacteria.

PROF. MOLLER, of Lund, Sweden, has published the Ephemerides of Faye's comet for its next return to the neighbourhood of the sun. It will be in perihelion about July 18, and will continue to approach nearer and nearer to the earth till Jan. 10, 1874. It will not, however, be in a position favourable for observation, and it is very probable that not even the most powerful telescope will be able to catch it.

M. CALLAS in *Les Mondes* endeavours to account for a dry haze (*brouillard sec*) which is seen in the atmosphere at certain seasons in particular countries. At Paris he says it is clearly visible on the horizon on the morning of lovely summer days, and is regarded as the presage of fine warm weather. It is of a light roseate hue. In proportion as the day is dry and warm, the denser and higher above the horizon is the haze. This haze is seen at all heights, having been observed by Saussure in Switzerland, by Lecav and Charles Martin in Auvergne, and by Wilkomer in Spain; in all cases, the phenomenon is seen at its best when the day is dry and warm. M. Callas attributes it to the combustion of aerolites and shooting stars. The attraction of the earth, he says, causes these bodies to deviate from their regular course and to be precipitated to the earth's surface with a rapidity which certainly exceeds 20 kilometres per second, and which is sufficient to set them on fire and render them volatile. The vapours thus produced rapidly become so rarified that they may be looked upon as the ultimate limit of divisibility of insoluble bodies and form the dry mists alluded to. Obeying the law of gravity these descend to the earth from the heights where they are formed, slowly however, on account of their extreme tenuity. As they approach the earth they come under the influence of winds which dissipate them, and of cold moisture, which absorbs them. Hence it is that they are perceived only in certain countries and in warm seasons; especially in Spain, and on the table-lands of Abyssinia and Mexico. M. Callas thinks that the haze may be regarded as a sort of cosmical matter akin to that which composes the tails of comets. The hypothesis has the merit of being at least curious, and so far as we know, original.

THE first paper in the last number of the Bulletin of the French Geographical Society is in connection with a well-executed map of the chief physical features of Eastern Brazil, appended to the number. M. Charles Grad contributes a long article on the geology of the Algerian Sahara and its system of waters. Perhaps the most interesting article is by M. Paul Gaffanel on the Great Sargasso Sea in the middle of the Atlantic, the history of which he traces from the Phœnicians downwards, describes its geography historically and with reference to what is known of it at present, which seems to be comparatively little, and concludes by pointing out that the wrack or algæ of which it is composed might be put to immensely profitable industrial uses.

WE have received the prospectus of the new Italian Geographical Magazine, whose first appearance we announced last week. Dr. Petermann has written a very hearty preface for his young friend, the editor, Guido Cora, whose plan is very comprehensive, embracing not only geography proper, but also geognosy, botany, zoology, anthropology, ethnography: hence the name of the magazine,—*Cosmos.* We wish it ample success.

THE *Revue Scientifique* for Feb. 8 contains Dr. Liebreich's Royal Institution lecture on the effect of School Life on Vision in the Young.

SIR W. ARMSTRONG ON THE COAL QUESTION *

II.

AT the present moment attention is being drawn to a new method of increasing the efficiency of the steam engine by pumping heated air into the boiler. It is impossible to conjecture what theoretical considerations could have led Mr. Warsop, the discoverer of the system, to anticipate beneficial results from the adoption of such an expedient, and yet the experiments that have been made in proof of its efficacy are so authoritative that they cannot be repudiated on the ground of their being unsupported by theory. This subject, although much debated of late, is still so ambiguous and obscure that I shall take the present opportunity of stating the difficulties of the case in the hope of eliciting satisfactory explanation. Mr. Warsop's method consists in attaching to a steam engine a forcing pump for the purpose of injecting air into the boiler. The pipe from this forcing pump is formed into a coil in the flue so that the air may absorb a portion of the waste heat. After entering the boiler the pipe is laid along the bottom, and being perforated with holes allows the air to bubble up through the water at many different points. The result appears to be that, with a given expenditure of fuel, the available power of the engine is considerably increased by the action of the air-pump, notwithstanding that the power for working it is derived from the engine itself. How, then, is this to be explained? It is clear that air forced into a receiver cannot without the aid of extraneous heat give back all the power expended upon the forcing pump. There must of necessity be loss of power by friction, and also from the impossibility in practice of realising all the expansive action of the condensed air corresponding to the compressive action of the pump prior to actual injection taking place. It would be a liberal estimate to assume that one-half of the power expended on the pump is recoverable from the air. Hence, to make up the deficiency by the application of heat, we should have to double the volume of the air, which would require it to be heated to upwards of 500° F, above its initial temperature. Now, in the case of the Warsop arrangement, considering the inconsiderable heating power of the escaping gases to which the air-pipe is exposed; considering also the slow absorbing power of air, and the smallness of the surface presented by the coiled pipe, it is hard to believe that the air could enter the boiler at such a temperature as I have named; but even if it did, where is the surplus power to be found that gives the engine a palpable increase of efficiency? The mere reaction of the compressed air, with all the aid it can possibly derive from the absorption of waste heat, would barely save a loss, and certainly could never account for an important gain. It seems obvious, therefore, that whatever beneficial action is exercised by the air must be of an indirect nature, and not the immediate effect of its mechanical energy.

Four modes of action have been put forward to account for the effects obtained. Firstly, it is said that the air, in bubbling through the water, facilitates the disengagement of the steam. This may very possibly be the case, for we know that water, entirely deprived of air, may be heated in an open vessel to a temperature greatly exceeding the usual boiling point, before ebullition commences. The reason of this is, that the adhesion between the water and the containing vessel, and also between the particles of water themselves, is sufficient to restrain the formation of steam at the usual boiling heat, unless air be present to afford points of separation. So far the explanation is plausible; for if the abstraction of air from water raises the boiling point, we may infer that the addition of air will lower it. But the reduction of the boiling-point within any supposable limits, would not lessen the quantity of heat required for the production of the steam sufficiently to afford a solution; because the sum of the latent and sensible heat, though not constant, as was formerly supposed, does not vary in relation to the boiling point to such an extent as would account for any important saving in that direction. A tangible advantage might, however, accrue from the accelerated transmission of heat from the fire to the water, caused by the increase of difference which a lowered boiling point would occasion between the temperature of the water and that of the fire and gases acting on the boiler; but in the absence of thermometric experiments to show how much the boiling point is actually reduced, and how much the escaping gases are cooled, it is impossible to form any definite opinion as to the amount of this saving. It is certain, however, that unless the reductions of temperature be greater than can be readily conceded, they will not be sufficient to account for so large an economy as is said to be realised.

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* Continued from p. 272.

Secondly, it is argued that the bubbles of air virtually afford an extension of heating surface. So they do, in relation to the heat carried in by the air; but the air can only part with its heat by lessening its direct contribution to the power of the engine. Moreover, if the heat carried in by the air be insignificant in quantity, as I believe it to be, the explanation fails in every point of view.

Thirdly, it is stated that the action of the air prevents and even removes incrustation, and thereby keeps the heating surfaces free from all obstruction as regards the transmission of heat. Very careful observation would be required to establish this fact; but, granting the fact, it would follow that the advantage of injecting air would be limited by those cases in which deposit would otherwise be formed. In a boiler perfectly free from incrustation the injection of air ought to be nugatory, but this does not appear to be the case.

Fourthly, it has been ingeniously suggested by Mr. Siemens that the air passing with the steam into the cylinder may form a film on the interior surface capable of arresting, in a great measure, that condensation which is known to be so wasteful of power in unjacketed cylinders, where the steam is used expansively. It is highly probable that the air would really accumulate in this manner against the sides of the cylinder; because, while the particles of steam sank down into water, the particles of air would remain. It is also pretty clear that this film of air would intercept the abstraction of heat by the cooled material of the cylinder; but if we admit this mode of action, then it would seem to follow that it is only in the absence of a steam jacket to the cylinder that the economy of injecting air is realised, and in fact that the injection of air is merely a substitute for steam jacketing. Moreover, if such be the action of the air, pumping into the steam should, in this point of view, produce the same effect as pumping into the water.

I have dilated upon this subject more, perhaps, than necessary, but I have done so with a view to stimulate action in the matter, for it is time that the doubts and obscurities which beset the system should be cleared up, and its adoption or rejection be brought to an issue. There is no class of steam-engine in which economy of fuel is of so much importance as it is in marine engines, for not only is it an object in steam navigation to diminish the cost of coal, but it is a still greater object to save room, and thereby increase the space available for cargo. The introduction of compound engines has enabled steam to be used of much higher pressure than formerly, and with greatly increased expansive action. The result has been a saving of about 50 per cent. in the consumption of coal, and I believe I am substantially correct in saying that in steam vessels, employed on long voyages, this saving of coal has been attended with a fourfold increase of the previous carrying power. It is highly probable that still further reductions of fuel will be effected by following in the same path, which has already lead to such great economy. The pressure of steam in marine engines is still far inferior to that which is used in locomotive engines, and there is no obstacle, of an insurmountable nature, against the expansive action being increased proportionately to any further increase of pressure.

But our efforts to increase the efficiency of marine engines must not run too much in one groove. Recent improvements have been almost exclusively directed to the mode of *applying* the steam, and but little attention has been paid to the mode of *producing* it. The engine has advanced enormously in improvement, but the boiler has actually receded; for we now get less evaporative effect from marine boilers than was obtained from those previously in use. This diminution of effect has resulted from changes made in the form of the boiler, to enable it to resist the greater pressure of the steam; but there is no inherent necessity for sacrificing evaporative power to meet this requirement, as is proved by the example of the locomotive boiler, which, while it produces steam of double the pressure of that supplied by marine boilers, stands unrivalled in regard to evaporative effect. The superiority of the locomotive boiler in regard to evaporating power is chiefly due to the large capacity of its firebox, which affords ample space above the surface of the fuel for perfecting the combustion of the gases. In the old form of marine boiler the flame space above and beyond the fire was also very large, and the evaporation per pound of coal was nearly as great as in the locomotive. But this advantage has been sacrificed in the modern form of boiler, by adopting a cylindrical fire chamber within the boiler. This form is very favourable to strength, but it affords very little head-room over the fire, and the consequence is that, although the tubular heating surface is relatively as great as before, the evaporation per pound of coal has fallen considerably. I do not say that the locomotive form of boiler, pure and simple, is that which ought to be adopted for marine engines, but it is well worth consideration, whether by adopting the same principle of construction, a more efficient boiler would not be obtained for marine engines. A more powerful draught would probably be required than is now necessary, but this could be obtained by known mechanical methods, applied either to *draw* air through the furnaces, or to *force* it into a closed stoke-hole. The production of draught by auxiliary power, would have the great advantage of enabling the rate of combustion to be regulated at pleasure, so as to meet the varying demand for steam, and it would also facilitate the application to marine boilers of mechanical firing, which does not succeed with a slow draught, and requires a variable draught to meet the fluctuating production of steam required at sea. The great number of stokers required in large steamers, the severity of the work, and the inefficiency of the method they pursue, as evidenced by the dense clouds of smoke they produce, render the introduction of mechanical firing in such vessels a matter of the utmost importance; and I do not believe that any of the difficulties which appear to stand in the way are incapable of removal.

I must not dismiss the subject of steam power without some allusion to its application to agriculture. In no description of steam-engine has economy of fuel been more perseveringly and successfully followed out than in engines for agricultural use; and Mr. Bramwell, in his late address to the Mechanical Section of the British Association, does full justice to the mechanical engineers who have been the means of bringing these engines to such a high degree of efficiency. It is satisfactory to see that the application of steam to the cultivation of the land, and to every kind of farming operation, is rapidly extending; for if the food producing power of the land has to be increased, it must be by substituting, as far as possible, the comparatively cheap power of steam, for the labour, both of men and horses. The greatly increased demand for labour in manufacturing occupations, as well as for mining and constructive purposes, will certainly diminish the supply of rural labour and increase its cost. Such a result is not to be regretted, considering how miserably ill requited farm labour in most parts of England has been; but unless the growing cost of agricultural labour and of horse work can be counterpoised by a more extensive use of steam power, we may expect much of the land in this country to be thrown out of cultivation. Very different are the views of those who maintain that food would be more economically produced by increasing, instead of diminishing, the labour employed on the land. Such is the doctrine of those who advocate the parcelling out of the land in small plots to peasant holders, and who even contend that waste lands, incapable of profitable return by ordinary treatment, could, by this means, be advantageously cultivated. It would, indeed, be a retrograde step to renounce the aid of capital and mechanical skill in tillage, and fall back upon the primitive system of spade husbandry. If there be a country in the world where such a mode of cultivation is the best, that country is assuredly not England, where all the resources of science and skill are necessary to the maintenance of a large population, under adverse conditions of soil and climate, and where labour is more highly paid in manufacture than in agriculture.

I have had considerable personal experience of steam cultivation, and am a thorough believer in its efficacy; but I may here draw attention to a very general subject of complaint concerning the machinery and implements employed for the purpose. I refer to the frequency of breakages due to insufficient strength in the construction. If makers of the apparatus, used in all the varieties of steam tillage, could only be induced to be more liberal in the use of material, the introduction of their machines would be very greatly accelerated.

I must also touch upon the subject of steam traction on common roads, which has lately received a considerable impulse from the introduction of Mr. Thomson's invention of India-rubber tyres. The number of horses in this country is enormous, and being great consumers of food, their maintenance is a heavy charge on the resources of the nation. Next to human power, horse power is the most expensive that we can use, and we may welcome the dawn of a period when steam will, to a great extent, supplant animal power in our streets and highways.

But these, and all other extensions of steam power, involve greater consumption of coal, and we may well look with anxiety to our diminishing stock of this precious mineral, which, when once expended, can never be replaced. It will therefore, be a fitting conclusion to this address briefly to review the results arrived at by the late Royal Commission, of which I was a member, as to the extent of our available coal and its probable duration. I will not trouble you with the vast amount of detailed information collected by the Commissioners as to the extent of the British coal fields, nor with the elaborate calculations of the quantities of coal which those coal fields contain, but I will chiefly direct my observations to those points of the inquiry which fall within the province of mining and mechanical engineering, and to the broad conclusions at which the Commissioners arrived.

It being well known that a great extent of our coal lies at depths greatly exceeding those of our present deepest mines, it was essential to the inquiry that the limit of possible depth of working should be approximately defined. One of the committees, therefore, into which the Commission was divided, was entrusted with this branch of the subject, and having acted in the capacity of chairman to that committee, I am especially familiar with its proceedings. It fortunately happens that water is never met with in large quantities at great depths, and it is easy to exclude it from the upper portion of a deep shaft, by the modern process of encasing the shaft with cast-iron segments. Nothing, therefore, is to be feared on the score of excessive pumping power being required; neither would there be any practical difficulty in drawing coals from the utmost depth to which we should have to descend. Steel wire ropes tapering in thickness towards the downward end, would not be overstrained by their own weight added to the usual load, and even if the depth were carried to such an extreme as to render the strain on the rope due to its weight a serious difficulty, the alternative of drawing at two stages could be adopted.

With regard to explosive gas it might have been anticipated that the greater superincumbent weight upon deep coal would cause more gas to exude, and thereby render the workings more fiery, but this does not appear to be the case. On the contrary, the evidence given before the committee on this point was to the effect that the evolution of gas appeared generally to diminish with increase of depth. In short, the only cause which it is necessary to consider as limiting the practicable depth of working, is the increase of temperature which accompanies increase of depth. The rate of this increase of temperature is about 1° F. for every 60 feet in depth, starting from 50 feet from the surface, where the temperature is in this country 50° at all seasons. The questions involved in this increase of temperature are, at what depth would the air become so heated as to be incompatible with human labour, and what means could be adopted to reduce the temperature of the air in contact with the heated strata. A great deal of interesting evidence was heard by the Commission as to the limit of human endurance of high temperature. The natural temperature of the human body, or rather of the blood which circulates through it, is 98°. A higher temperature is the condition of fever, and the maximum of fever heat appears to be about 105°. Labour appears to be impossible, except for very short intervals when the external conditions are such as to increase materially the normal temperature of the blood. The temperature of the air may be considerably in excess of 98° without unduly heating the blood, provided the air be very dry, because the rapid evaporation which then takes place from the body keeps down the internal temperature; but if the air be humid, this counter-action does not take place, or not in a sufficient degree, and then the blood absorbs heat from the surrounding medium and the condition of fever sets in. Now, in a coal mine, the air is never very dry, and is often very moist, and we must, therefore, regard a temperature of 98° in a coal mine as the extreme limit that could be endured by men performing the work of miners. For my part, I believe this temperature is beyond the limit of possible continuous labour in a mine, and most persons familiar with the interior of coal mines will agree with me in thinking that even 90° would prove a very distressing temperature, and one which would render the cost of labour much greater than usual. However, granting the practicability of working in a coal mine in an atmosphere at 98°, the next question is, what depth would involve that temperature of the air? The depth at which the earth would exhibit a temperature of 98° would be about 3,000 feet, but it is a different question at what depth the air circulating through the mine would acquire that temperature. The air being cold when it enters the workings at the bottom of the shaft, absorbs heat with great avidity from the surfaces of the passages through which it flows. As it travels along it continues to absorb heat, but less rapidly as its own temperature increases. The rate of absorption is complicated by the superficial cooling of the passages by the contact of the air. This cooling action is necessarily greatest near the shaft, where the air is coldest, and diminishes by increase of distance, so that both the air, and surfaces against which it sweeps, become hotter as the length of the air-course is increased. The progress towards complete assimilation of temperature is much slower in the permanent air courses than at the working face of the coal, because the coal at the face being newly exposed is hotter, and therefore communicates heat more readily to the air. In any case, however, the air will eventually acquire the heat due to the depth, if its contact with the strata be sufficiently prolonged. It follows, therefore, that the temperature of the air in a mine depends on the extent of the workings as well as on the depth of the pit. But great depth involves extensive workings, because the cost of the sinking could only be repaid by working a large area of coal. Extremely deep mines will consequently possess *both* the conditions tending to produce a high temperature of the air, and unless those conditions can be counteracted by some artificial expedient, the air would acquire the temperature of 98°, assumed to be the limit of practicable labour at a depth not greatly exceeding 3,000 feet.

It is a common idea that increase of temperature may be kept down to any extent by increase of ventilation, but this opinion will not bear examination. In the first place it requires an extravagant increase of motive power to accelerate the velocity of the current of air in any considerable degree, because the resistance increases in a ratio somewhat exceeding the cube of the velocity. In fact, the only way of materially increasing the volume of air is by enlarging the sectional area of the shafts and air-courses, which would be attended both with difficulty and expense. Assuming, however, that it would be generally practicable to effect a large increase of ventilation under the conditions incident to extremely deep mining, it is necessary to consider what would be the cooling effect realised by so doing. This is a very complex question, because the reduction of temperature in the air increases the emission of heat from the strata, and because the rate of absorption is affected, not only by difference of temperature, but also by the velocity of the current.

The uncertainty on the question of the power of air to absorb heat when flowing at different velocities and in different volumes through heated air-courses, and the difficulty of reasoning out any conclusion upon the subject led me to make, for the guidance of the committee, a series of experiments in which air was forced, in varying quantities, through pipes of different lengths and sizes, immersed in hot water, the temperatures being observed at the point of emergence. In these experiments the pipes were regarded as representing, on a small scale, the air-courses of a deep mine; the hot water being the equivalent of the heated strata through which the air would be conveyed. The particulars of these experiments will be found in the appendix to the evidence taken by the committee, and the results are embodied in tables, illustrated by diagrams, which show the progressive heating of the air as it travels along the passages, and exhibit the reductions of temperature effected by successive increments of the volume of air. From these tables and diagrams it will be seen that, with short pipes, representing short distances from the shaft, increased circulation has considerable effect in lowering temperature; but with pipes representing long distances from the shaft, the cooling effect of increasing the volume of air becomes insignificant. The conclusion to which the committee came, as to the depth at which coal could be worked, is expressed in the following words:—"The depth at which the temperature of the earth would amount to 98° would be about 3000 ft. Under the long-wall system of working a difference of about 7° appears to exist between the temperature of the air and of the strata at the working faces; and this difference represents a further depth of 420 ft., so that the depth at which the temperature of the air would, under present conditions, become equal to the heat of the blood, would be about 3,420 ft. Beyond this point the considerations affecting increase of depth become so speculative, that the committee must leave the question in uncertainty; but they consider that it may be fairly assumed that a depth of at least 4,000 ft. could be reached."

The committee decline to deal with hypothetical expedients for overcoming the difficulties, but they recognised the possibility of future discovery and experience counteracting, in some unknown degree, the effects of heat and humidity in restricting the depth of working. It will, therefore, be for mining and mechanical engineers to bring all the resources of their science to bear upon this difficult problem of counteracting terrestrial heat, at depths where it approaches the limit of human endurance. The Commissioners adopting 4,000 ft. as the probable limit of practicable depth, came to the conclusion that there exists in this kingdom an aggregate quantity of about 146,480 millions of tons of available coal. If we assume that the future population of this country will remain constant, and that the consumption for domestic and manufacturing purposes, including exportation, will continue uniform at the present quantity, or merely vary from year to year without advancing, then our stock of coal would represent a consumption of 1,273 years. But if, on the other hand, we assume that population and consumption will go on increasing at the rate exhibited by the statistics of the last fifteen years, or, I might probably say, of the last fifty years, had accurate statistics been so long recorded, then the whole quantity of coal would, as shown by Mr. Jevons, be exhausted in the short space of 110 years. It will be generally admitted that the truth is likely to lie between these two extremes. The Commissioners refrained from expressing an opinion as to what the period of duration would actually be, but they presented certain alternative views of the question, resulting in periods varying from 276 to 360 years. But, all these estimates of duration have reference to the time required for absolute exhaustion of available coal, and leave untouched the important question of how long we are likely to go on before we become a coal-importing instead of a coal-exporting country. The computation of quantities made by the Commissioners, includes all coal seams exceeding 1 ft. in thickness, whatever the quality may be, and it is obvious that vast quantities of such coal can never be worked, except at a price which would render it more advantageous to purchase coal from abroad than to work it from such unfavourable beds. If, at the present time, while working our best and most available coal, our markets will barely exclude the coal of Belgium, what will be our position when driven to inferior coal more costly to work? If we look to cheaper labour for enabling us to work less valuable coal, I fear we shall look in vain; but there is one hope for a longer endurance of our prosperity as dependent on our coal, and that hope rests on the skill and perseverance of mining and mechanical engineers, who, even now, are called upon to lessen, by all the resources of mechanical science, the amount of human labour required in coal mines.

SCIENTIFIC SERIALS

THE *Monthly Microscopical Journal.*—The first paper is one of Mr. Parker's excellent studies, being on the osteology of the head of the sparrow-hawk. The first paragraph contains a generalisation which will surprise many ornithologists, for the Cariama is included among the raptorial birds; is this a result of the study of the skull? The accompanying drawings are excellent.—Dr. Royston-Piggott gives two articels, "On an Aërial Stage Micrometer," and "On the Spherules which compose the Ribs of the Scales of the Red Admiral Butterfly, and the Lepissna Saccharina."—An ingenious method of obtaining an equal illumination in both tubes of a binocular is contributed by Mr. W. R. Bridgman; and Mr. Stewart endeavours to prove that the hair follicles of the negro's scalp are curved instead of straight; he also describes clearly the framework of the sucking feet of the Echinus.—These papers are followed by abstracts of interest, including several from the American journal, the *Lens.*

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Feb. 6.—"Memoir on the Osteology of Hyopotamidæ," by Dr. W. Kowalevsky. The paper is intended to fill a deficiency in our knowledge of the extinct creation by giving a complete osteology of one family of the Paridigitate Ungulate. It has been supposed that fossil representatives of this family would exhibit a less reduced skeleton and a more complete number of digits than recent genera; yet such is not the case. The genera *Anoplotherium* and *Liphodon* present in their feet the same degree of reduction as in recent Ruminants, save the confluence in a canon-bone. Notwithstanding this, they have been considered the progenitors of the Ruminantia, from a deficiency in other forms. The present paper introduces a new form, known only by the teeth till now; these, the *Hyopotamidæ*, vary considerably in specific and generic form, ranging from the Lower Eocene up to the Lower Miocene period, and in size from a rabbit to a hippopotamus. The Eocene species, except one termed *diplopus*, have not lost the lateral digits, and are included in the genus *Hyopotamus*. The division of the Ungulata into *Paridigitata* and *Imparidigitata* must have occurred about the cretaceous period, as shown by the diversity exhibited by both groups from the lowest Eocene. The former, the *Paridigitata*, split very anciently, perhaps in the chalk, into those with tubercular, and others with crescentic teeth. These groups, once separate, kept entirely apart, but frequently followed parallel lines of descent. Following these two divergent lines of descent, both groups culminate at the present time in such forms as *Phacochœrus* and *Dicotyles* for one group, and the *Bovidæ* for the other, links between these being absent. The Paridigitata with crescentic teeth will be termed *Par. selenodonta*, and those with tubercular *Par. bunodonta*. To the first group belong *Anoplotherium*, *Liphodon*, *Hyopotamus*, and others, together with the existing ruminants, whilst the second embraces the *Suina*, *Hippopotamina* and *Entelodon*. There is in some cases difficulty in deciding whether the teeth are tubercular or crescentic, the lobes being so thick.

It is important to find some osteological characters to confirm the above division, and the hand and foot from their variations suggested probable data. In tracing the Paridigitata in time, there is a marked tendency to the gradual reduction of the manus and pes, and an advantage to the individual apparently arises from the simplification. By comparison of all forms, a simple structure of the manus and pes may be obtained, such as was probably possessed by the common ancestor, and such a type is nearly retained by *Hippopotamus*, and was possessed by *Hyopotamus*. In none of these forms is the limb pentadactylate. Supposing the feet to be pentadactylate, the following is the disposition of the digits in the type:—The two outer digits (the fourth and fifth) are always supported by one bone, the unciform in the manus, and the cuboid in the pes; the three succeeding inner digits are supported each by a separated bone, the third, second and first cuneiform in the pes, and the os magnum, trapezoideum, and trapezium, in the manus. In the latter the third digit touches the unciform, and the second the magnum; the second digit of the pes touches the third cuneiform. The first digit being lost in all Ungulata, the trapezium and first cuneiform support the second digit.

Beginning with this type, which was probably exhibited by the progenitors of the Paridigitata, the reduction along both lines of descent may be followed, and in doing so a series of parallel modifications may be obtained, though it is found among the crescent-toothed line that the reduction is much more rapid than along the tubercular toothed. By reduction of the foot is meant that locomotion is carried on by the two middle toes instead of by the original four; and this seems to be an advantage to the organism, as it is exhibited by all descending lines of Ungulata. Going further into detail, it is found that both in Selenodont and Bunodont Paridigitata, a two-fold method of reduction of the manus and pes, a simple or *inadaptive*, and an elaborate or *adaptive* method is observed. In the first or *inadaptive* mode of reduction, the foot, whilst losing its lateral digits, acquires no better adaptation to altered circumstances of locomotion than is derived from the mere thickening of the remaining digits. The relation between the carpal and tarsal bones, and the remaining two metacarpal and metatarsals, remains unaltered, and the remaining digits do *not* enter into any modification by which they can receive more ample support from the carpal and tarsal bones, by taking the place formerly occupied by the reduced digits. *Anoplotherium*, *Liphodon*, and *Hyopotamus*, are examples of this method of reduction.

In the second or *adaptive* method of reduction, the middle digits grow larger and thicker than in the first mode; but while broadening transversely they do not adhere to the ancestral type, but tend to gain a support on *all* the bones of the carpus and tarsus, pushing the lateral digits to the side and thereby gaining a better and more complete support for the body. The lateral digits, being rendered useless, tend to disappear, and the remaining digits, being pressed from both sides by the carpal and tarsal bones, tend to coalesce to form the *canon* bone of recent ruminants, or of the hind foot of *Dicotyles*. In this, the *adaptive* method, modification keeps pace with inheritance, and examples of it may be seen in *Sus*, *Dicotyles*, *Hyæmoschus*, and the Ruminants.

All extinct Paridigitata follow the first or *inadaptive* mode of reduction, whilst all living genera follow the second. Did the former not become extinct because of their incapacity to adapt themselves to altered circumstances, and the latter survive from being able to adapt themselves more fully to those circumstances? From an examination of fossil remains, it is found that the Paridigitates, of the genus Hyopotamus, were Selenodonta of the *inadaptive* line of descent, inheritance in them being stronger than modification. Among the Bunodonta following the *inadaptive* method, the old representatives are but little known, *Listriodon* and *Elotherium* being the most certain, and the latter apparently didactylate.

Following the adaptive method, among the Selenodonta are *Chœrotherium*, *Palæochœrus*, and the Swine, and the culminating or most reduced stage is not yet reached among the *Suina*, but it is certainly the direction in which they tend. Among the Bunodonta there is great difficulty in tracing the line of descent whence originate the Ruminantia. From the existence of *Hyæmoschus* we may predict that they were originally tetradactylate, and there are many other intermediate conditions, as *Tragulus* and *Gelocus*.

"Magnetic Survey of Belgium in 1871." By Rev. S. J. Perry. The magnetic observations which furnished the results contained in this paper were made during the Autumn months of 1871.

The instruments used and the methods adopted were almost identical with those employed in previous magnetic surveys of France.

The dip was observed by Mr. W. Carlisle, magnetic assistant of Stonyhurst Observatory, and the rest of the observations were taken by the Rev S. J. Perry.

This new series of determinations of the terrestrial magnetic elements was rendered the more necessary, as preceding observers had chosen very few stations in Belgium, and as the curvature of the isodynamics and isoclinals in Dr. Lamont's maps of Belgium, Holland, and North-west Germany, indicated a very considerable disturbing cause in the first-named country.

The values obtained in 1871 are a strong confirmation of the suspicions of irregularity, to which former observations had given rise. For although the lines of equal dip, declination, and horizontal force bear a sufficiently close resemblance to those of neighbouring countries, there is evidence of much disturbance; and when the valves of the dip and horizontal force are combined, the isodynamics show clearly that the coal-measures, which stretch completely across the south east portion of Belgium, exercise a strong disturbing influence. This local magnetism might be incapable of producing more than a decided curvature of the isodynamics of an extended tract of country; but when all the stations of observation are situated within narrow limits, the perturbation completely masks the normal direction of the lines.

The following is a complete list of the magnetic elements observed at the different stations, and reduced to the common epoch of January 1, 1872.

Station.	Declination.	Dip.	Horizontal force.	Intensity.
	°	°		
Aix-la-Chapelle..	16·464	66·637	4·0064	10·1025
Alost	17·349	67·210	3·9518	10·2016
Antwerp..........	17·489	66·999	3·9296	10·0559
Arlon..............	16·398	65·907	4·1175	10·0857
Bruges............	17·938	67·155	3·8950	10·0321
Brussels..........	17·959	66·975	3·9613	10·1271
Courtray..........	17·756	66·678	4·0028	10·1103
Ghent..............	17·823	67·221	3·9197	10·1232
Liége	16·233	66·464	4·0145	10·0522
Lierre	—	66·948	—	—
Louvain............	16·824	66·898	3·9565	10·0828
Mechlin	—	66·714	—	—
Mons................	17·216	66·573	4·0065	10·0767
Namur..............	17·541	66·538	3·9941	10·0311
Ostend	18·097	67·211	3·9152	10·1077
Spa	16·627	66·653	4·0239	10·1531
Tournay..........	17·691	66·632	3·9975	10·0776
Tronchiennes	17·867	67·361	3·9032	10·1397
Turnhout..........	17·025	66·113	3·9542	10·1665
Verviers..........	—	66·718	—	—
Secular variation	−0·1255	−0·0573	+0·00542	−0·01155

Zoological Society of London, February 4.—Professor Huxley, F.R.S., V.P., in the chair.—A letter was read from Mr. Henry W. Piers, late acting curator of the South African Museum, Capetown, containing remarks on a specimen of the *Chimæra australis*.—Mr. E. Blyth exhibited and made remarks on some Tiger Skins from India, Burmah and Siberia.—A communication was read from Mr. R. Meldola, containing remarks on a certain class of cases of variable protective colouring in insects.—A communication was read from Mr. G. Gulliver, F.R.S., containing a series of measurements of the Red Blood Corpuscles of various Batrachians.—A paper was read by Dr. A. Günther, F.R.S., containing an account of certain species of Reptiles and Batrachians, obtained by Dr. A. B. Meyer in Celebes and the Philippine Islands.—A communication was read from Mr. A. G. Butler, containing a monographic revision of the genera *Zephronia* and *Sphærotherium* of the sub-order Myriopoda, together with descriptions of some new species of these genera.—A communication was read from Mr. G. French Angus, containing descriptions of eight species of Land and Marine Shells from various localities.—Messrs. P. L. Sclater and Osbert Salvin read the sixth of a series of papers on Peruvian Birds, collected by Mr. H. Whitely, in the Andes of Peru. The present communication contained an account of eighty species, collected principally at Cosnipetz, in the province of Cuzco.—A communication was read from Mr. H. Whitely, containing notes on the Humming Birds collected and observed by him in the Andes of Peru.—A communication was read from Dr. J. E. Gray, F.R.S., on the genus *Ocadia*, which he considered should be referred to the family *Bataguridæ*.

Chemical Society, February 6.—Dr. Williamson, F.R.S., vice-president, in the chair.—A communication was made by Dr. H. E. Armstrong "On the action of Sodium on Aniline."—A paper on "Anthrapurpurine," by Mr. W. H. Perkin, was then read by the author. Anthrapurpurine is a colouring matter which accompanies alizarine in the crude "artificial alizarine," now so largely manufactured and employed in dyeing instead of madder. Like alizarine it is capable of imparting brilliant and fast colours to cloth mordanted with alumina or iron.—A paper was also read by Dr. C. R A. Wright on "Isomerism in the terpene family of hydrocarbons." In it he gives an account of his experiments with oil of nutmegs and oil of orange-peel.

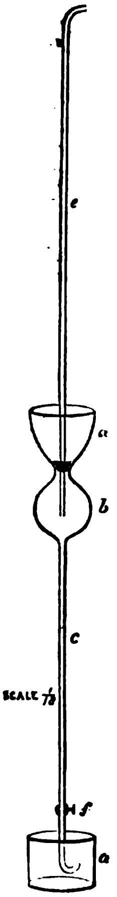
Anthropological Institute, Feb. 4.—Col. A. Lane Fox, vice-president, in the chair.—Mr. W. L. Distant read a paper on the inhabitants of Car Nicobar." The people of Car Nicobar are taller than the average Malay, and darker in the colour of the skin. Their faith in a good spirit is slight, and in an evil spirit, which is invested with a personality, is strong. Their honesty is so well known that traders at once deliver their stores on the promise of these islanders to pay the necessary number of cocoanuts in return; and the promise is always fulfilled. They take but one wife, and adultery is severely punished.—A paper by Mr. J. E. Calder was read on the extirpation of the native tribes of Tasmania." The author who had had the advantage of above forty years' experience of the Tasmanians, entered very fully into their physical and mental characteristics, habits, customs, and modes of warfare, and the causes which led to the rapid extinction of all the tribes. They were intelligent, capable of considerable culture, and showed every disposition to become civilised; but the abundant supply of food induced indolence, which, together with the sudden and violent change of habit from savage to civilised life was one of the chief causes of extinction. The chairman announced the appointment of a Committee of Psychological Research.

Entomological Society, January 27, Annual Meeting.—Professor Westwood, president, in the chair. Statement of treasurer's account for 1872 read, and report of council.—Professor Westwood was re-elected as president for 1873, Messrs. S. S. Saunders, G. H. Verrall, C. O. Waterhouse and J. J. Weir, new members of council; Mr. McLachlan as treasurer; Messrs. F. Grut and G. H. Verrall, secretaries, and Mr. E. W. Janson as librarian.—The president delivered an address on the progress of entomology during the past year.

Geologists' Association, Feb. 7.—The Rev. T. Wiltshire, M.A., the retiring president, in the chair.—Henry Woodward, F.G.S., was elected president for 1873; and Robert Etheridge, F.R.S., Prof. Morris, F.G.S., James Thorne, F.S.A., and the Rev. T. Wiltshire, M.A., vice-presidents. Messrs. W. Hislop, J. L. Lobley, and A. Bott were re-elected treasurer, honorary secretary, and honorary librarian respectively. The report for the year 1872 shows the association to be in a flourishing state, and was unanimously adopted.

MANCHESTER

Literary and Philosophical Society, Dec. 24, 1872.—The president, Dr. J. P. Joule, F.R.S., drew attention to the increasing number of cases of hydrophobia. There was every reason for believing that this dreadful disorder was communicated from one animal to another by a bite, and seldom, if ever, was spontaneously developed. Inasmuch therefore as the effects of a bite nearly always occurred within four months, it would only be necessary to isolate all dogs for that period in order to stamp out the disease. That was the opinion of Dr. Bardsley, whose elaborate paper will be found in the fourth volume of the Memoirs of the Society, and probably gave rise to the practice of confining dogs at certain periods of the year, which has unfortunately been rendered to a great extent nugatory in consequence of having been only partially adopted.



Jan. 7.—The president referred to the great loss which the Society had experienced by the death of one of its most distinguished honorary members, Dr. Rankine; called away in the prime of life, his loss is one of the most severe that could have befallen science.—Mr. William H. Johnson called attention to the action of sulphuric and hydrochloric acids on iron and steel. If after immersion for say ten minutes in either of these acids a piece of iron or steel be tested, its tensile strength and resistance to torsion will be found to have diminished. Exposure to the air for several days, or gentle heat will, however, completely restore its original strength. Prolonged immersion in acid has a tendency to produce a crystalline structure in even the best wrought iron.

January 21.—The president explained a simple apparatus by means of which a very high degree of rarefaction of air could be produced with much facility, and which might in some circumstances be found preferable to the common air-pump or even the Sprengel. It consists of a glass funnel *a* surmounting a globe *b*, from the lower part of which a tube *c* descends to a jar of mercury *d*. The tube *e*, in connection with the receiver to be exhausted, is furnished with a vulcanised india-rubber plug which fits into the neck of the funnel. In using the apparatus the stopcock *f* is shut and the funnel filled with mercury. Then by lifting the tube *e* with its plug, the mercury fills the globe *b* and the pipe *c*. The tube *e* is then replaced, and the stop-cock being opened, the mercury descends in *c*, emptying the globe. By returning the mercury into the funnel by means of a pump, or more simply, by lifting the jar *d*, the process is repeated until the requisite degree of rarefaction is produced.

PARIS

Academy of Sciences, Jan. 27.—M. de Quatrefages, president, in the chair.—M. A. Trecul read the second part of his paper on the carpellary theory of the Papaveraceæ. This portion of the paper treats of *Glaucium* and *Eschscholtzia*.—M. Boussingault read a note on alimentary substances preserved by cold. The author exposed several articles of food to a temperature of - 20° for several hours in closed flasks; this was in 1865. The substances are now perfectly sound and free from putrefaction.—M. Th. Lestiboudois read the continuation of his paper on the structure of the *Heterogenæ*.—M. Marès read a note on the vine sickness characterised by Phylloxera. The paper was referred to the commission on that subject.—A letter from M. I. Pierre on the determination of the boiling point of liquid sulphurous anhydride was then read. The method consists in introducing a thermometer, through a pierced cork, into a thin tube containing the anhydride. Another hole in the cork holds an exit tube; the apparatus is then suspended in the air, the SO_2 begins to boil, and the thermometer is then read.—M. Faye presented M. Heis's "Atlas cœlestis novus," and made some quotations from it on the number of stars visible to the naked eye; the author can see many stars put down by other astronomers as of the 7th or 8th magnitude.—M. L. d'Henry read a paper on the use of the mono-chromatic sodium light in observing the tints of litmus in alcalimetry. The author finds that this reaction is much more easily seen by the yellow light.—M. Ch. Valson sent a note on the modulus of refrigerating power in saline solutions.—MM. C. Friedel and R. D. Silva sent a note on a new tertiary alcohol, &c.; M. H. Joulie a note on the commercial estimation of nitrates; and MM. Gayon one on the spontaneous alteration of eggs: the author finds the putrid eggs full of vibriones; he intends to seek for the origin of these bodies.—M. Gréyhant sent a note on the estimation of carbonic oxide combined with hæmoglobin.—M. F. Pisani sent a paper on the analysis of Jeffersonite from New Jersey, and on the analysis of Arite from Mount Ar (Basses Pyrénées).—M. S. Chautrain sent a paper on the reproduction of eyes in the crayfish. The author has cut out the eyes of the crustacean, and finds that they grow again in about eleven months.

DIARY

THURSDAY, FEBRUARY 13.

ROYAL SOCIETY, at 8.30.—On Curvature and Orthogonal Surfaces: Prof. Cayley—On a New Relation between Heat and Electricity: Prof. Guthrie

SOCIETY OF ANTIQUARIES, at 8.30.—On a Brass Bowl of the 12th century: T. A. Gardiner—On Early Deeds and Charters: R. H. Wood.

MATHEMATICAL SOCIETY, at 8—On Systems of Linear Congruences: Prof. H. J. S. Smith.—Application of the Hodograph to the Solution of Problems on Projectiles: J Macleod.

FRIDAY, FEBRUARY 14.

ASTRONOMICAL SOCIETY, at 8.—Anniversary.

ROYAL INSTITUTION, at 9.—On Recent Progress in Weather Knowledge: R. H. Scott.

QUEKETT CLUB, at 8.

SATURDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 3.—Comparative Politics: Dr. E. A. Freeman.

SUNDAY, FEBRUARY 16.

SUNDAY LECTURE SOCIETY, at 4.—Pre-Historic Fortifications: Lawson Tait.

MONDAY, FEBRUARY 17.

LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

ENTOMOLOGICAL SOCIETY, at 7.

ASIATIC SOCIETY, at 3.

COLLEGE OF SURGEONS, at 4.—Osteology and Dentition of Extinct Mammalia, with their Geological and Geographical Distribution, &c.: Prof. Flower (Hunterian Lectures)

TUESDAY, FEBRUARY 18.

ANTHROPOLOGICAL INSTITUTE, at 8.—Note on the Macas Indians: Sir John Lubbock, Bart.—On the Relation of the Parish Boundaries in the South East of England to Great Physical Features: William Topley.

ZOOLOGICAL SOCIETY, at 8.30.—Report on the Hydroida collected during the Expeditions of H.M.S. Porcupine: Prof. G J. Allman.—On Œgithognathous Birds: W. K Parker.—Notes on the Anatomy of the Binturong (*Arctictis binturong*): A. H Garrod.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, FEBRUARY 19.

SOCIETY OF ARTS, at 8.

METEOROLOGIAL SOCIETY, at 7.—Description of an Electrical Self-registrating Anemometer and Rain-gauge: Fenwick W. Stow.—On the Madras Cyclone of May 2, 1872: Capt. H. Toynbee.—On the Character of the Storm of August 21–23, 1868, over the British Isles: Capt. T. O. Watson.—On some Results of Meteorological Telegraphy: Robert H. Scott.

LONDON INSTITUTION, at 7.—Paper and Discussion.

COLLEGE OF SURGEONS, at 4.—Hunterian Lectures.

BOOKS RECEIVED

ENGLISH.—On the Miracle recorded in Joshua x.: Rev. E. Biley (Hatchard).—Lessons on Elementary Anatomy: St. G. Mivart (Macmillan).

FOREIGN.—Annuaire de l'Academie Royale de Belgique, 1873.—Lehrbuch der Physik: 2nd part, 1873.—Fauna der Kieler Bucht, vol ii.: H. A. Mayer and R. Robins (Englemann: Leipzig).

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DIARY 296

ERRATUM.—No. 171, p. 275, 1st col., line 7 from bottom: for "boiled *Bacteria*" read "living *Bacteria*."

THURSDAY, FEBRUARY 20, 1873

THE PRESERVATION OF OUR NATIONAL MONUMENTS

THE necessity of some measures being taken for the preservation of our national pre-historic monuments is constantly being forced upon public attention by the acts of destruction so frequently reported in the newspapers, and which, it would appear, the power of public opinion is by itself unable to prevent.

We have only to refer to any archæological work which treats of our cromlechs and dolmens, and other megalithic monuments, to see at once how fearfully many of them have been mutilated, if they have not been absolutely destroyed within the last century or two. The disappearance of the monolith near Kit's Coty House, which, though fallen in Stukeley's time, was still there to mark what was then known as "the general's grave;" the hopeless confusion into which the "Countless Stones," also near Aylesford, have been thrown; the cairns within the circle, known as Long Meg and her Daughters, which, since Camden's time, have vanished, while the Daughters appear to have been reduced in number from 77 to 68; the double row of immense stones near Shap, the destruction of which has been so great that a village has been almost entirely built out of their remains;—these are but a few examples of this kind culled at random from Fergusson's "Rude Stone Monuments."

It was, moreover, only last year that a portion of Avebury, a monument perhaps only second in importance to Stonehenge, was threatened, and was only saved for posterity by the public-spirited liberality of Sir John Lubbock, who purchased the site.

With barrows and earthworks the destruction has been equally rapid, though less noticed. We have, however, seen an expostulation in the *Times* on the subject of the vallum of an ancient circular camp being converted into bricks, and the threatened destruction of Cæsar's Camp at Wimbledon is still a matter of public interest.

It is, perhaps, rarely the case that these monuments are destroyed in a merely wilful manner; it is usually from economical motives. The barrows offer a mound of soil well adapted for being carted away to give a top dressing to some neighbouring field, and there is also the secondary advantage, that their site, after the removal of the mound, offers no impediment to the passage of the plough. The stones of the megalithic monuments offer supplies of material both for the purposes of building and the repair of the neighbouring roads. As it was with "the Egyptian mummies, which Cambyses or Time had spared and which Avarice now consumeth," so it is with these rude monuments of our forefathers. When the belief was strong that "Mizraim cured wounds," there was some excuse for "mummies becoming merchandise," and Pharaoh being sold for balsams;" but to dress our fields with the sepulchral mounds of our predecessors, and to break up their monuments for the repair of our barns and roads, seems to us what Sir Thomas Browne would have stigmatised as a worse than "irrational ferity."

It is with a view to preventing such barbarisms that Sir John Lubbock has introduced a Bill in the present Session of Parliament, to make provision for the preservation of certain national monuments, which has now been read a first time. The means adopted for dealing with this somewhat difficult subject appear to us well calculated for producing the desired result, and in a manner which even those who consider they have a right to destroy any monuments on their own property, cannot but regard as equitable.

The conservation of monuments such as barrows, dolmens, menhirs, earthworks, stone-circles, &c., is placed by the Bill under the charge of a body of Commissioners, consisting of the Inclosure Commissioners, the Master of the Rolls, the Presidents of the Societies of Antiquaries of London and of Scotland, the Keeper of the British Antiquities at the British Museum, and three other Commissioners to be nominated by the Crown. Under their charge are placed certain monuments specified in a Schedule attached to the Bill; but, with the consent of the Treasury, other monuments of a similar kind may, at any future time, be brought under their control. When once this has been done, any injury or damage to the monuments will be treated as a malicious injury and become penal, unless the written permission of the Commissioners has been obtained, or they have declined to purchase either the monument itself, or a power to restrain the owner or occupier of it from injuring it during a certain period of years.

Powers are given to the Commissioners to purchase the freehold, or other estate, in any monument and rights of way for the public to it, as well as to exercise the power of restraint from injury. The amount of compensation to be awarded under either head is to be determined under the provisions of an already existing Act of Parliament; but in all cases the consent of the Treasury will be necessary before there can be any outlay of public money.

These are the main provisions of the Bill, but the necessary clauses with regard to notices, powers of access, conservation of monuments, and other matters, have not been omitted, and have evidently been carefully considered. The Schedule attached to the Bill is at present apparently undergoing revision, but about eighty of the principal prehistoric monuments of the United Kingdom are already specified.

It appears to us that it would be wise for the local societies in our different counties to furnish Sir John Lubbock with catalogues of the principal monuments in their respective districts, such as in their opinion ought to be placed under the protection of the Commissioners, so as to make the list as complete in the first instance as possible, and avoid the necessity of making continual additions to it.

The mere fact of a barrow, dolmen, or camp, being thought of sufficient importance to be cited by name in an Act of Parliament would tend to raise it in the respect of the inhabitants of the surrounding country, and in most cases suffice to preserve it from wanton injury. The general spread of education will also do much to encourage a regard for our national antiquities, of which, notwithstanding neglect in the past, we have still a fair number to show. Let us do what we can to preserve them ere it be too late, and not let posterity charge the present generation with neglect, should at some future time a greater interest arise in these relics of a dim past, and it then be found that of monuments now extant all that can be said will be " Etiam periere ruinæ."

In France it is certainly the case that where a building or other ancient structure is " classé comme monument historique," it is regarded with some degree of pride and affection by those who live near it, and the necessary expenses for the preservation of such monuments do not appear to be grudged.

In this country, also, what small expense the Treasury might incur in the defence and preservation of our national monuments would, we are sure, be cheerfully met; but we are inclined to think that it will only be in rare and exceptional cases that any outlay whatever, beyond, perhaps, the expense of a few notices, will be necessary.

Among the multitude of private Bills brought in at the commencement of a Session, it is not always that the doctrine of the "survival of the fittest" applies. In this instance, however, we trust that the Bill will be exposed to neither neglect nor mishap. It is supported by members on both sides of the House; it does not appeal to Party, but to the patriotism of the whole nation, and it is brought in under the auspices of a member whose reputation as an archæologist, though great throughout the country, is exceeded by his popularity as the author of the most successful measure of private legislation in modern times—the Bank Holiday Act.

HERBERT SPENCER'S PSYCHOLOGY

The Principles of Psychology. By Herbert Spencer. Second Edition. (London: Williams and Norgate.)

I.

To give readers some idea of the contents of a good book is very often the most useful thing a reviewer can do. Unfortunately that course is not open to us in the present instance. The subject is too vast. We cannot exhibit the grandeur; we can only in a few general phrases express our admiration of the profound, all-embracing philosophy of which the work before us is an instalment. The doctrine of evolution when taken up by Mr. Spencer was little more than a crotchet. He has made it the idea of the age. In its presence other systems of philosophy are hushed, they cease their strife and become its servants, while all the sciences do it homage. The place that the doctrine of evolution has secured in the minds of those who think for the educated public may be indicated by a few names taken just as they occur. Mr. Darwin's works, the novels of George Eliot, Mr. Tylor's "Primitive Culture," Dr. Bastian's "Beginnings of Life," and Mr. Bagehot's "Physics and Politics," have almost nothing in common but the idea of evolution, with which they are all more or less imbued. In a word we have but one other thinker with whom in point of influence on the higher thought of this, and probably of several succeeding generations, Mr. Spencer can be classed:—it does not need saying that that other is Mr. J. S. Mill.

As we cannot present such an outline of Mr. Spencer's system of psychology as would make it generally intelligible, the purpose of directing attention to the work will perhaps be best served by selecting as the subject of remark one or two points to which the presence of the controversial element may lend a special interest. After pointing out that the cardinal fact brought to light when nervous action is looked at entirely from the objective point of view, is, that the amount and heterogeneity of motion exhibited by the various living creatures, are greater or less in proportion to the development of the nervous system, Mr. Spencer comes to the vexed question of the relation between nervous phenomena and phenomena of consciousness. This is a subject about which in its more subtle aspects there is much uncertainty and some confusion of thought. It may be taken as established that every mode of consciousness is a concomitant of some nervous change. Given certain physical conditions accompanied by a special state of consciousness, and there is every reason to believe that physical conditions in every respect identical, will always be attended by a similar state of consciousness. This, and not more than this, we think, was intended by Mr. Spencer in his chapter on Æstho-physiology. Nevertheless, several able men have, it would appear, been led to suppose that he countenances a kind of materialism (not using the word to imply anything objectionable, for why not be materialists, if materialism be truth?), which forms no part of his philosophy. To give precision and emphasis to what we say, we would take the liberty to refer to the position taken up by Dr. Bastian in his remarkably able and] important work on the "Beginnings of Life." The expression that definitely raises the issue of which we wish to speak, and which at the same time fixes Dr. Bastian to a view not in harmony with the teaching of Mr. Spencer, is the following:—"We have not yet been able to show that there is evolved, during brain action, an amount of heat, or other mode of physical energy, less than there would have been had not the Sensations been felt and the Thoughts thought;" but he believes that this is the case. Our present object is not so much to show that here speculation has got on a wrong track, as that, if we understand Mr. Spencer, it is not his opinion that anything of this kind takes place; though certainly some ambiguous phrases might be held to convey this meaning. We have mentioned the significant fact that the size of the nervous system holds a pretty constant relation to the amount and heterogeneity of motion generated. The implication is that none of the motion evolved during nervous action disappears from the object world, passes into consciousness in the same sense that physicists speak of momentum passing into heat; that whether consciousness arise or not, there will be for the molecular motion set up in the nerve substance, exactly the same mechanical equivalents. Whether, for example, those ganglia that in the body of each one of us are employed in carrying on what we call reflex action, are so many distinct seats of consciousness, like so many separate animals, an idea for which much has been said, or whether the nerve-changes that go on in these ganglia have no subjective side; in either case the objective facts will remain the same. If consciousness is evolved, it is not at the expense of a single oscillation of a molecule disappearing from the object world. No doubt it is hard to conceive consciousness arising in this apparently self-created way; but if any suppose that by using phrases that would assimilate mind to motion they ease the difficulty, they but delude themselves. It is as easy to think of consciousness arising out of nothing, if they will, as to conceive it as manufactured out of motion; that is to say, the one and the other proposition are alike absolutely unthinkable. On this point Mr. Spencer writes, "Can we think of the subjective and objective activities as the same? Can the oscillations of a molecule be presented in consciousness side by side with a nervous shock, and the two be recognised as one? No effort enables us to assimilate them. That a unit of feeling has nothing in common with a unit of motion, becomes more than ever manifest when we bring the two into juxtaposition." Mr. Spencer's idea is that feeling and nervous action are two faces of the same ontological something,—a view that prohibits the notion of the one passing into or being expended in producing the other. The conclusion is that the transformations of physical energy remain unaffected by the presence or absence of consciousness.

Psychology has as yet been made a serious study by only a few individuals. Accordingly it is only the more striking and easily grasped peculiarities of Mr. Spencer's system that can be referred to with advantage. Of these the most imposing, and the one of which the educated public have already a slight second-hand acquaintance, is the doctrine that the brain and nervous system is an organised register of the experiences of past generations, that consequently the intelligence and character of individuals and of races depend much more on this, on the experiences of their ancestors, than on their individual experiences. The flood of light thrown by this conception on so many things previously dark and unfathomable, its power of bringing about harmony where before there was nothing but confusion and unsatisfactory wrangling, ought to have been sufficient to have secured it a universally favourable reception. This, however, has not been the case, and partly, perhaps, because of the very merits that recommend it. It may be that veterans who have won their laurels on, say, the battle-field of innate ideas, love the old controversy, and are not anxious to learn that both sides were right and both wrong. Moreover, it is the misfortune of this important addition to psychology, that it shows that previous workers in this field of inquiry have at times been labouring in the dark to solve problems like in kind with the famous difficulty of accounting for the supposed fact, that the weight of a vessel of water is not increased by the addition of a live fish. For instance, should Mr. Spencer be right, the celebrated theory of the Will, elaborated by Prof. Bain, the able representative of the individual-experience psychology, becomes a highly ingenious account of what does not happen. Thus, the new doctrine can be accepted only at the expense of giving up much of what has hitherto passed for mental science.

The following sentences will serve to indicate Mr. Spencer's position: "The ability to co-ordinate impressions, and to perform the appropriate actions, always implies the pre-existence of certain nerves arranged in a certain way. What is the meaning of the human brain? It is that the many *established* relations among its parts stand for so many *established* relations among the psychical changes. Each of the constant connections among the fibres of the cerebral masses, answers to some constant connection of phenomena in the experiences of the race." "Those who contend that knowledge results wholly from the experiences of the individual, ignoring as they do the mental evolution which accompanies the autogenous development of the nervous system, fall into an error as great as if they were to ascribe all bodily growth and structure to exercise, forgetting the innate tendency to assume the adult form." "The doctrine that all the desires, all the sentiments, are generated by the experiences of the individual, is so glaringly at variance with facts, that I cannot but wonder how anyone should ever have entertained it." The circumstances which account for the existence of the individual-experience psychology, and which enable it still to hold out as a rival of the more advanced form that Mr. Spencer has given to the science are these: (1) the immaturity of the human infant at birth; (2) the lack of precise knowledge with regard to the mental peculiarities of the lower animals; (3) the still popular notion that the human mind does not resemble the mental constitution of the animals, that it is of a different order. Of course this last is now-a-days little more than a popular superstition, nevertheless it can be taken advantage of; and an argument to the effect that the mental operations of the animals are, to all appearance, so very different from the workings of the human mind, that they can supply nothing more than a worthless, if not a misleading analogy, has a very specious and scientific look about it, in the eyes of those who are not very well acquainted with the subject. Our ignorance of animal psychology may be still more boldly drawn on in defence of the theory under consideration. With a hyper-scientific caution, its advocates refuse to take into account anything (incompatible with their theory) concerning any one species of animal that has not been proved by a very overwhelmingly large number of very accurate observations. And they find it possible to maintain that it still remains unproved that any species of animal possesses either knowledge or skill not wholly acquired by each individual. A better acquaintance with the mental peculiarities of the animals is certainly a desideratum, and we hope that this rich field of investigation will not long remain uncultivated. In *Macmillan's Magazine* for this month there is an account of a series of observations and experiments on young animals by the present writer, which, unless they can be discredited, may reasonably be expected to go far to establish the fact of instinct, the fact of innate knowledge and unacquired skill; in other words, the phenomena on which the experience-psychology, minus the doctrine of inheritance, can throw no light whatever. Now, had not Mr. Darwin banished from every scientific mind the hypothesis of the miraculous creation of each distinct species of animal just as we see it, with all its strange organs and, to most people, still stranger instincts, the presumption against a system of human psychology that not only can give no account of the most striking phenomena in the mental life of the animals, but which strongly inclines those who hold it to pronounce such phenomena incredible, might not have been so apparent. But in the present state of our scientific knowledge, such a psychology, professing to be a complete system, is self-condemned. In its fundamental principles the science of mind must be the same for all living creatures. Further, if man be, as is now believed, but the highest, the last, the most complex product of evolution, a system professing to be an analysis and exposition of his mind, yet confessing itself incompetent to deal with the necessarily simpler mental processes of lower creatures, must surely feel itself in an uncomfortably anomalous position.

It is, however, on the first-mentioned circumstance, the immaturity of the infant at birth, that most stress can be laid. The newly-born babe cannot raise its hand to its mouth, and doubtless for a long time after birth it has no consciousness of the axiom "things that are equal to the same thing are equal to one another." The helplessness of infancy is pointed to as furnishing ocular demonstration of the doctrine that, whatever may be the case with the animals, all human knowledge, all human ability to perform useful actions, must be wholly the result of associations formed in the life-history of each individual. But it can surely require little argument to show that this is an entirely unwarranted assumption. It might as well be maintained that because a child is born without teeth and without hair, the subsequent appearance of these must be referred wholly to the operation of external forces. Of the several lines of argument that might here be employed, let us, for the sake of freshness, take the analogy from the lower animals. We are not aware that it can be asserted as the result of prearranged and careful observations, that any creature at the instant of birth exhibits any of the higher instincts. A number of isolated and more or less accidental observations have been recorded; and apparently on the strength of these Mr. Spencer has made the following unqualified statement:—" A chick, immediately it comes out of the egg, not only balances itself and runs about, but picks up fragments of food, thus showing us that it can adjust its muscular movements in a way appropriate for grasping an object in a position that is accurately perceived." The fact is, that on emerging from the shell, the chick can no more do anything of all this than can the new-born child run about and gather blackberries. But between the two there is this great difference, that whereas the chick can pick about perfectly in less than twenty-four hours, the child is not similarly master of its movements in as many months. Our present point is, that it can be shown by experiment that the performances of the chick a day old, which involve the perceptions of distance and direction by the eye and the ear, and of many other qualities of external things, are not in any degree the results of its individual experiences. Let it now be remembered that, in the absence of conclusive evidence to the contrary, it has been considered a safe position to hold that the early knowledge and intelligent action of the chicken "may be, after all, nothing more than very rapid acquisitions, the result of that experimentation, prompted by the inborn or spontaneous activity." May we now, on the other side, similarly presume, until the contrary is shown, that the more tardy progress of the infant is not because its mental constitution has to be built up from the foundation out of the primitive elements of consciousness, which the chicken's has not, but rather because the child comes into the world in a state of greater physical, and therefore mental immaturity? The progress of the infant, however, has been so continually spoken of as if it were a visible process of unaided acquisition, that it may give some surprise when it is asserted from the other side that we have no sufficiently accurate acquaintance with the alleged acquisitions of infancy to justify the doctrine that they are different in kind from the unfolding of the inherited instincts of the chicken. To give definiteness to the attitude taken up, we would say, for example, that the facts concerning the early movements of the two lambs and the calf observed by Prof. Bain, and which, looked at from his point of view, were strong confirmation of the doctrine of individual acquisition, may be just as readily interpreted as the unfolding of inherited powers; which, as far as we know, start into perfect action at the moment of birth, in no single instance. From observations on several newly-dropped calves, the facts corresponding substantially with those recorded by Prof. Bain, the present writer could draw no conclusive evidence in favour of either the one theory or the other. One observation, however, may here be mentioned that seemed rather to favour the doctrine of inheritance. A calf one hour old, which had been staggering about on its legs for ten minutes, stepped out at the open door of the byre. It no sooner found itself in the open air, than it began to frisk and dance; it was left entirely to itself, and when it had been on its legs fifteen minutes, it—apparently in obedience to the feeling of fatigue—deliberately lay down, folding in its limbs after the established manner of its kind. This is all we know about calves; about children we know nothing at all. And it may fairly be asked how, when called in question, the assumption that underlies such statements as the following can be made good. We quote from Prof. Bain's account of the growth of voluntary power. He says:—" The infant is unable to masticate; a morsel put into its mouth at first usually tumbles out. But if there occur spontaneous movements of the tongue, mouth, or jaw, giving birth to a strong relish, these movements are sustained, and begin to be associated with the sensations; so that after a time there grows up a firm connection.' Bearing in mind that when born the child has no occasion for the power of masticating solid food; that the ability to suck, which involves an equally complex series of muscular adjustments, is what it requires, and this it has by instinct; bearing all this in mind, the question is, why may not the innate ability to masticate be developed by the time it is required quite as spontaneously as the teeth used in the operation? Take a parallel. The feeble nestling when it leaves the shell is blind. One of the several very pronounced and interesting instincts it exhibits at this stage is, that in response to certain sounds it opens its mouth and struggles to hold up its head to be fed. Several weeks later it begins to pick for itself. Now we put the question, is this second mode of filling its stomach to be considered a pure acquisition, while its original plan must certainly be regarded as pure instinct? No one, we think, will venture to answer in the affirmative; the more so as this is a case that may any day be put to the test of experiment. Where, then, is the evidence that the analogous progress from drawing milk to masticating solid food is of a different kind?

DOUGLAS A. SPALDING

OUR BOOK SHELF

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Zweites Heft: (Breslau, 1872.)

THIS part contains the following memoirs:—Dr. Ciesielski, "Investigations on the downward Curvature of the Root." Dr. Frank "On the position and direction of floating and submersed parts of plants." Dr. Cohn "On Parasitic Algæ." Dr. Schroeter "On certain Pigments formed by the Bacteriæ," and Dr. Cohn's "Investigations on Bacteriæ."

This work—Cohn's "Beiträge zur Biologie der Pflanzen"—is the organ more especially of the workers in the phyto-physiological laboratory at Breslau, under the guidance of the eminent Professor of Botany in the University there. The first part appeared in 1870 (NATURE, vol. iii. p. 242).

Dr. Ciesielski's researches follow up the interesting inquiries into the same subject opened a few years ago by Prof. Hofmeister and others. He sums up with the following propositions:—

1. The normal growth of germinating seedlings may be observed in a saturated atmosphere, if the albumen or cotyledons be kept constantly moist, without the root descending into either water or moist earth. The development of the root ceases however as soon as the reserve of nutrient matter in the seed is exhausted.

2. The longitudinal extension of the root takes place exclusively in a relatively narrow region behind the tip.

3. The downward curvature of the root takes place at that point where the longitudinal growth of its cells is at a maximum.

4. Gravitation occasions the downward curvature.

5. This curvature is not passive but active; that is to say, gravitation occasions in the root a tension of the tissue whenever it departs from its normal direction, and thus determines downward curvature.

6. This tension is due to the more considerable growth of those cells which lie on the side of the root turned towards the zenith.

7. The more marked growth of the cells of this side of the root is occasioned by the circumstance that the cell-contents of the upper side turned towards the zenith are much less concentrated than in the under side; which, again, is due to the action of gravity which determines that the more concentrated cell-sap, being the heavier, shall occupy the under side of the root.

8. If the outermost tip (*Vegetationskegel*) of a root be cut off, it may indeed elongate through mere extension of its tissues, but it is no more capable of downward curvature.

9. If however it afterwards developes a new formative apex, as occasionally happens, and so elongates at the cut apex, the root again becomes capable of downward curvature.

10. Centrifugal force determines in a similar manner and on analogous ground, the curvature of the root in the direction of this force, as does gravitation in that towards the nadir.

The next thing will be to explain the relation of *ascending* axes to gravitation. It would seem as though heliotropismus and geotropismus had squabbled over the embryo and compromised matters at last by each taking a *Vegetationskegel*, one of the plumule the other of the radicle, with its active future control!

Dr. Frank's paper is an inquiry into the causes which influence the position and direction of the floating and submersed leaves of aquatic plants apart from the direct operation of gravity and sunlight, which are not causes directly productive of special modifications of growth, but rather guides according to which the organ in the course of growth adjusts itself so far as it is able, until it has attained a position the most advantageous to it.

Prof. Cohn's memoir touches upon the question, of peculiar interest just now, of the relation of the lower forms of vegetable life destitute of chlorophyll to the organic matter in which they find their matrix and to the inorganic world, with regard to their power of assimilating independently their necessary nutriment and reducing carbonic acid. He also carefully describes as a new unicellular genus of truly parasitic algæ, *Chlorochytrium* (allied to *Hydrocytium* and the *Chytridinæ*) which he finds inhabiting the fronds of *Lemna trisulca*. The occurrence of this chlorophyll—containing alga in *Lemna*, he regards as presenting an analogy with the presence of the green gonidial layer in lichens, which he looks upon similarly as an endophytal alga.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Janssen-Lockyer Application of the Spectroscope

I SEE by a letter in the *English Mechanic and World of Science* of January 31, that Mr. R. A. Proctor claims for Dr. Huggins the credit of having publicly described in Feb. 1868, the method of viewing the solar protuberances without a total eclipse.

Permit me to state that to Mr. Lockyer undoubtedly belongs the credit of having known this method even before his preliminary paper in 1866 in which it was sufficiently published. We had numerous conversations on the subject, and when he showed me the MS. of his preliminary paper and told me at the same time that he was about to ask a grant for the purpose of procuring a more powerful spectroscope, I advised him to introduce his views in the shape of a question, which he accordingly did in the following terms:—"May not the spectroscope afford us evidence of the existence of the 'red flames' which total eclipses have revealed to us in the sun's atmosphere, although they escape all other methods of observation at other times? and if so may we not learn something from this of the recent outburst of the star in Corona?"

I gave this advice to my friend, Mr. Lockyer, because I thought that as it might be some time before he obtained the new instrument it might be well that he should publish what I conceived would enable him to claim for himself the knowledge of this principle. And I think that anyone well acquainted with spectra on reading the question put, could not fail to see what was meant, and if he were previously ignorant of the principle, he could not fail to perceive it. I therefore feel rather astonished that anyone should claim the statement made by Huggins two years afterwards as being the commencement of a new principle. The method founded upon this principle was first successfully applied by Messrs. Janssen and Lockyer, acting independently of each other, in the year 1868. Mr. Lockyer had by this time obtained his improved spectroscope, and the very first day he used it he made the discovery. I do not think there is any reason to suppose that Mr. Lockyer was at all aided, as was suggested by Mr. Huggins, in detecting these lines by the somewhat vague information of what had been done at the total eclipse in India. He was now provided with an instrument capable of showing these lines to a child—made in fact for the purpose of showing them. Now what would have been thought of any one of the Indian observers if during the few minutes of a total eclipse he had failed to detect the existence of bright lines? Can we imagine therefore that an intelligent observer like Mr. Lockyer, with an instrument constructed for the purpose and with unlimited time at his disposal, should have failed in detecting such lines even had he not previously been sure that they existed? I confess I cannot understand any observer failing in a thing of this nature, and therefore I do not know well how to account for the somewhat puzzling remark made by Dr. Huggins in his notes to Schellen's "Spectrum Analysis" as follows:—

"Though to Mr. Lockyer is due the first publication of the idea of the possibility of applying the spectroscope to observe the red flames in sunshine, as a matter of history it should not be passed over that, about the same time, the same idea occurred quite independently to two other astronomers, Mr. Stone of Greenwich, and Mr. Huggins. These observers were however unsuccessful in numerous attempts which they made to see the spectra of the prominences, for the reason probably that the spectroscope which they employed was not of sufficient dispersive power to make the bright lines of the solar flame easily visible. When the position of the lines was known, Huggins saw them instantly with the same spectroscope (two prisms of 60°), which he had previously used in vain."

I confess I cannot yet understand why a distinguished observer like Dr. Huggins, possessing such an instrument as he did, should fail to have seen the bright lines at first, nor why, believing as he did in the aid afforded by the Indian observations to an observer searching for these lines, he should yet have left it to Mr. Lockyer to make this discovery.

BALFOUR STEWART

Dr. Bastian's Experiments on the Beginning of Life

IN the issue of NATURE for January 9, Dr. Burdon Sanderson has recorded some experiments on the behaviour of certain organic mixtures boiled for five or ten minutes in flasks which were hermetically sealed during ebullition. He found, as Dr. Bastian had done, that Bacteria appeared in these sealed vessels —not always, but frequently. Dr. Sanderson is, however, careful not to endorse the conclusions which Dr. Bastian has drawn from these experiments. This method of experimenting appears to me to involve two serious sources of error which invalidate them in so far as they are used to support the theory of spontaneous generation.

The first source of error is the possibility of the introduction of atmospheric germs at the moment of sealing.

Those who are practised in the sealing of flasks during ebullition are aware that the sealing can only take place just as ebullition is about to cease; otherwise the vessel bursts, or the imprisoned steam opens a path for itself through the softened glass where the flame is being applied. There is thus at the moment of sealing, a risk of some reflux of air into the flask and a consequent vitiating of the experiment. Perhaps it may be thought that because air thus introduced has to pass through the flame applied to the tube through the red-hot tube itself, and enters a flask whose contents are not far below the boiling temperature, any germs contained in it must be destroyed; but that is a very hazardous assumption. *Momentary* contact (or approximate contact) with a flame or a heated surface is by no means so destructive as at first appears, and experience has taught me to suspect that the contents of a boiling flask are not speedily deprived of vitality. This source of error is probably not a frequent occurrence in Dr. Bastian's experiments, but I am inclined to think that it was a frequent one in Dr. Wyman's experiments, and that it seriously vitiates all those experiments in which air passed through a heated tube was used. At any rate the exactness of experiments so conducted is very much at the mercy of the care and dexterity of the operator, and hence, probably, their contradictory results in different hands.

In repeating Dr. Bastian's experiments I have avoided this source of error by inserting a tight plug of cotton wool in the neck of the flask before beginning to boil. In this way any chance germs introduced by an accidental reflux of air during sealing are prevented from passing into the flask.

The second source of error is much more important. It is this:—*Dr. Bastian's process does not insure that the entire contents of the flask are effectively exposed to the boiling heat.* Herein lies, I believe, the chief cause of the inconstant and contradictory results obtained by him. It is beyond doubt that Dr. Bastian is perfectly correct in his statement that the experiments made by Pasteur with "Pasteur's solution," and by Lister with urine, yield different results when made with other solutions and mixtures. The contrast is most striking. In my own experiments I have found that filtered infusions of any animal or vegetable substances (and I have tried a very great variety) can be invariably preserved unchanged when boiled for five or ten minutes in a flask plugged with cotton wool; but if milk be treated in the same way, or if a few fragments of a green vegetable be added to the infusion, or if alkaline albuminous solutions or mixtures, containing cheese, be treated in the same way, they almost invariably breed Bacteria in abundance. What is the cause of this difference? For some time it appeared to me difficult to account for, but I came to the conclusion at length that it was simply due to the fact, that with the more complex organic mixtures every particle of the material within the flask does not really attain the boiling heat. These more complex mixtures generally froth excessively in boiling, and spurt about particles which adhere to the glass, and probably some of these escape the full effect of the heat. What first led me to this conclusion was the behaviour of milk. Milk boiled for ten or even twenty or thirty minutes, in a plugged flask, almost invariably curdled and produced Bacteria in a few days; but when the milk was put into a long-necked flask, plugged with cotton wool, and hermetically sealed, and the flask boiled in a good-sized can of water for twenty or thirty minutes, then the milk remained permanently unchanged, and produced no Bacteria. I possess specimens of milk treated in this way which have remained unchanged for many months, though exposed to warmth, to light, and free access of air, that is to say, to air filtered through a good plug of cotton wool. I obtained similar results with the other organic mixtures which could not be kept unchanged by simple boiling over the flame. Highly putrescent mixtures, containing blood-serum, egg-albumen, fragments of meat and vegetables, remained perfectly barren after the flask containing them had been immersed in a water-bath kept at a boiling heat for twenty or thirty minutes.

The essential conditions of the experiment are, first, the effective exposure of the whole contents of the flask to a boiling heat; secondly, the absolute prevention of any fresh entrance of extraneous solid or liquid particles; and the conclusion I have come to is that if these conditions are rigidly observed, the flasks remain barren; if they do not remain barren it is simply because one or other of these conditions has not been observed.

Manchester WM. ROBERTS

The unreasonable

I UNRESERVEDLY accept Prof. Clifford's disavowal of the meaning I attributed to his words concerning Kant's Antinomies, in his Address (*Macmillan's Magazine*, Oct. 1872). At the same time I cannot allow that the misprision was wholly due to my "exuberant imagination." He said, "The opinion . . . is set forth by Kant . . . in the form of his famous doctrine of the antinomies," &c. This ought to mean that the "doctrine of the antinomies" is one form of that "opinion;" and the opinion being, "that at the basis of the natural order there is something which we can know to be *unreasonable*," I was fully justified by the mere words of the Address in the inference (which he disclaims) that he intended to identify the doctrine of the antinomies (the Antithetic, in fact) with that of the unreasonable basis of the natural order. How was I to know that the "something" was either (? which) "the transcendental object" or the world of *noumena*?

I premise, then, that it is the Antithetic which "is set forth by Kant in his famous [but little understood] doctrine of the Antinomies," and *not* "the opinion that at the basis of the natural order there is something which we can know to be unreasonable." Prof. Clifford, however, meant to signalise the latter; and he asserts, and by sundry extracts from the *K. r. V.* attempts to substantiate the assertion, that "the transcendental object [which lies at the basis of the natural order] is *unreasonable*, or evades the processes of human thought."

Now Kant, so far from proving (or asserting) *that*, takes pains to show that it is *reasonable*, though it persistently seems to be the reverse! According to Kant, the thing *per se* illusorily appears to be the object of experience; and this illusion is inevitable, and no criticism can dispel it. (Kant compares it to the seeming magnitude of the horizontal moon.) But criticism can and does explain it, so that, though it persists as a spectre haunting the reason, it is wholly and strictly amenable to the processes of reason, or in Prof. Clifford's sense, *reasonable.*

Of Prof. Clifford's quotations, (*a*) and (*b*) are irrelevant to his second position; the former does not directly touch "the processes of human *thought;*" the latter does not touch "the transcendental object!" His third position is equally unsupported by the extract, "Man [*not* Mann] kann aber," &c., which may be thus rendered:—"But conversely we can also deduce from this antinomy a real, not indeed a dogmatical, but a critical and doctrinal advantage, namely, of indirectly showing the transcendental ideality of phenomena (*Erscheinungen*)." The method is by showing that the antithesis is contrary, as distinguished from contradictory, and by invalidating both the alternatives, whence it follows that the subject of them is not an existing totality. The antinomies are thus used, not as Prof. Clifford vainly imagines, to prove that the transcendental object is unreasonable, but that the postulate of its being a *noumenon*, or thing *per se*, or true basis of the natural order, is untrue, both alternatives being false.

Prof. Clifford is, as I said, really attacking Hamilton. I do not care where he got the doctrine from, nor what he does with it. If it amuses him to set up these absurd nine-pins and then bowl them over, with flourish of trumpets, I have no wish to interfere with him, only he had better mind his H's and K's, and not impute this stuff to Kant. Once for all: in Hamilton's system the opposed propositions, which do show their subject to be unreasonable, are intended to do duty as contradictories. But in Kant's system the opposed propositions in an antinomy are only seeming contradictories, are virtually contraries, and their common subject remains the subject of an intelligible proposition, and one that Kant believes himself to have substantiated, after the contraries are invalidated: so that the subject is after all amenable to the processes of human thought, though not representing an object of experience. I dare not further trespass on the columns of NATURE to comment upon Prof. Clifford's views of the two legs of Kant's philosophy! Certainly the one leg is wholly due to my opponent's "exuberant imagination:" it is Hamilton's leg, not Kant's.

Athenæum Club, Feb. 17 C. M. INGLEBY

Inherited Feeling

THE remarkable case of an inherited feeling of dislike for a special class of persons, communicated by Mr. Darwin, appears to me to support a view I have long held (but not yet published) as to the explanation of another class of so-called instincts. The three separate instances given in which the dogs showed a violent antipathy to butchers, either without seeing them or when they were dressed as gentlemen, clearly indicates that it was through the sense of smell that the painful sensation was experienced; and this is quite in accordance with the wonderful delicacy and importance of this sense in most animals, and especially in dogs. It is natural to suppose that some ancestor of these dogs was systematically and cruelly ill-treated by several butchers, perhaps from some thievish propensity or other bad habit which required frequent punishment, so that the smell of a butcher came to be invariably associated with pain and a desire for revenge. But the most important fact to observe is, that there must be some peculiar odour developed in human beings by constant contact with flesh, which a dog can recognise apart from individual peculiarities and in spite of perfect disguise. Now the power many animals possess to find their way back over a road they have travelled blindfolded (shut up in a basket inside a coach for example) has generally been considered to be an undoubted case of true instinct. But it seems to me that an animal so circumstanced will have its attention necessarily active, owing to its desire to get out of its confinement, and that by means of its most acute and only available sense it will take note of the successive odours of the way, which will leave on its mind a series of images as distinct and prominent as those we should receive by the sense of sight. The recurrence of these odours in their proper inverse order—every house, ditch, field, and village having its own well-marked individuality—would make it an easy matter for the animal in question to follow the identical route back, however many turnings and cross-roads it may have followed. This explanation appears to me to cover almost all the well-authenticated cases of this kind.

ALFRED R. WALLACE

I AM able to corroborate the remarkable fact mentioned in Dr. Huggins's letter in your last.

My father possessed a mastiff, a son of Sybil, daughter of Turk, who has, ever since he was a pup, evinced the same antipathy to butchers. We have hitherto been unable to explain it, for he is always perfectly good tempered with other tradesmen who come to the house. The butchers have, on several occasions, tried to propitiate him by throwing him presents of meat, but although willingly enough received, it has done nothing towards abating his hostility. H. G. BROOKE

Hale Carr, Altrincham, Feb. 15

I HAVE a cat, of a long-haired breed, whose aversion to dogs is unusually strong. Last autumn, six kittens of hers, under two days old, were in a corner of the kitchen where they had had no opportunity of making acquaintance with any dog; yet, on being stroked (in their mother's absence) by a hand which a dog had just licked, more than one of them "swore" violently. This was repeated several times, but the little creatures showed no dislike to being touched with a clean hand.

A LOVER OF ANIMALS

TWO or three months ago I was walking with my two little girls near the railway bridge at West Kensington, when the children (who always find the attraction of a fine dog irresistible) made me stop to admire a tall and remarkably handsome mastiff, apparently the property of a man who stood by with a hand-barrow. He was speaking to two other men of this dog, and of another of the same kind which he had at home, and telling them that they were quiet and amiable to all men but butchers, and that it was not safe for a butcher to come near either of them. One of the men said that he believed all dogs of that breed showed the same antipathy; and added that when they were left loose at night to guard premises, they would always allow a policeman to enter.

This chance conversation is perhaps hardly worth troubling you with, as I have no means of ascertaining whether these dogs claimed kindred with Turk, but I send it to you, nevertheless.

M.

Kensington Square, Feb. 17

EFFECT OF LIGHT ON SELENIUM DURING THE PASSAGE OF AN ELECTRIC CURRENT.[*]

BEING desirous of obtaining a more suitable high resistance for use at the Shore Station in connection with my system of testing and signalling during the submersion of long submarine cables, I was induced to experiment with bars of selenium, a known metal of very high resistance. I obtained several bars varying in length from 5 to 10 centimetres, and of a diameter from 1 to 1½ millimetres. Each bar was hermetically sealed in a glass tube, and a platinum wire projected from each end for the purpose of connection.

The early experiments did not place the selenium in a very favourable light for the purpose required, for although the resistance was all that could be desired—some of the bars giving 1,400 megs. absolute—yet there was a great discrepancy in the tests, and seldom did different operators obtain the same result. While investigating the cause of such great differences in the resistance of the bars, it was found that the resistance altered materially according to the intensity of light to which it was subjected. When the bars were fixed in a box with a sliding cover, so as to exclude all light, their resistance was at its highest, and remained very constant, fulfilling all the conditions necessary to my requirements; but immediately the cover of the box was removed, the conductivity increased from 15 to 100 per cent. according to the intensity of the light falling on the bar. Merely intercepting the light by passing the hand before an ordinary gas-burner placed several feet from the bar increased the resistance from 15 to 20 per cent. If the light be intercepted by rock salt or by glass of various colours, the resistance varies according to the amount of light passing through the glass.

To ensure that temperature was in no way affecting the experiments, one of the bars was placed in a trough of water so that there was about an inch of water for the light to pass through, but the results were the same; and when a strong light from the ignition of a narrow band of magnesium was held about nine inches above the water the resistance immediately fell more than two-thirds, returning to its normal condition immediately the light was extinguished.

PARTING BANQUET TO PROF. TYNDALL

ON the evening of February 4 Prof. Tyndall's visit to the United States was crowned by a banquet at Delmonico's, New York, at which there were present about 200 of the most distinguished citizens of the country, presided over by the Hon. William M. Evarts. Among the company present were the following:—The Rev. Dr. Bellows, Parke Godwin, Dr. Draper, A. M.

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[*] Communicated to the Society of Telegraph Engineers, February 12, by Mr. Latimer Clark, from Mr. Willoughby Smith, Electrician to the Telegraph Construction Company.

Mayer, Rev. Henry Ward Beecher, President F. A. P. Barnard, Rev. Dr. Hitchcock, Rev. Dr. H. C. Potter, Dr. A. Flint, Dr. Hammond, Rev. Dr. Osgood, A. Appleton, G. S. Appleton, Judge Brady, Dr. H. Draper, V. Botta, J. C. Draper, Judge Daly, the Hon. E. D. Morgan, B. Silliman, Prof. G. F. Barker, of Yale College, Gen. Franklin, D. Van Nostrand, H. S. Kendrick, Prof. Chandler, Prof. S. F. Baird, of the Smithsonian Institute, Prof Michie, Prof. Pompelly, E. L. Godkin, Fred. Law Olmsted, Prof. W. H. Chandler, of Columbia College, Sterry Hunt, C. W. Field, Gen. Myers, E. L. Youmans, A. S. Hewitt, Wilson G. Hunt, Dr. Sims, Col. Dwight, J. B. Scribner, W. H. Appleton.

There were several very happy after-dinner speeches, by men of various professions and opinions. We present our readers with a few extracts from the speech of Prof. Tyndall.

Referring to the interest shown in his lectures, he said:—"Every such display of public sympathy must have its prelude, during which men's minds are prepared, a desire for knowledge created, an intelligent curiosity aroused. Then in the nick of time comes a person who, though but an accident, touches a spring which permits tendency to flow into fact, and public feeling to pass from the potential to the actual. The interest displayed has really been the work of years, and the chief merit rests with those who were wise enough to discern that, as regards physics, the detent might be removed, and the public sympathy for that department of science permitted to show itself. Among the foremost of those who saw this must be reckoned my indefatigable friend Prof. Youmans. In no other way can I account for my four months' experience in the United States. . . To no other country is the cultivation of science in its highest forms of more importance than to yours. In no other country would it exert a more benign and elevating influence. What, then, is to be done toward so desirable a consummation? Here I think you must take counsel of your leading scientific men, and they are not unlikely to recommend something of this kind. I think, as regards physical science, they are likely to assure you that it is not what I may call the statical element of buildings that you require so much as the dynamical element of brains. Making use as far as possible of existing institutions, let chairs be founded, sufficiently but not luxuriously endowed, which shall have original research for their main object and ambition. With such vital centres among you, all your establishments of education would feel their influence; without such centres even your primary instruction will never flourish as it ought. I would not, as a general rule, wholly sever tuition from investigation, but, as in the institution to which I belong, the one ought to be made subservient to the other. The Royal Institution gives lectures—indeed it lives in part by lectures, though mainly by the contributions of its members, and the bequests of its friends. But the main feature of its existence—a feature never lost sight of by its wise and honourable Board of Managers—is that it is a school of research and discovery. And though a by-law gives them the power to do so, for the twenty years during which I have been there no manager or member of the institution has ever interfered with my researches. It is this wise freedom, accompanied by a never-failing sympathy, extended to the great men who preceded me, that has given to the Royal Institution its imperishable renown.

"I have said that I could not wholly sever tuition from investigation, and I should like to add one word to this remark. In your chairs of investigation let such work as that in which I have been lately engaged be reduced to a minimum. Look jealously upon the man who is fond of wandering from his true vocation to appear on public platforms. The practice is absolutely destructive of original work of a high order. Now and then the discoverer, when he has anything important to tell, may appear with benefit to himself and the world. But as a general rule he must leave the work of public lecturing to others. This may appear to you a poor return for the plaudits with which my own efforts have been received; but these efforts had a special aim. My first duty toward you, moreover, is to be true, and what I say here is the inexorable truth.

"As to the source of the funds necessary for founding the chairs to which I have referred it is not for me to offer an opinion. Without raising the disputed question of State aid, in this country it is possible to do a great deal without it. As I said in my lectures, the willingness of American citizens to throw their fortunes into the cause of public education is without a parallel in my experience. Hitherto their efforts have been directed to the practical side of science, and this is why I sought in my lectures to show the dependence of practice upon principles. On the ground, then, of mere practical, material utility, pure science ought to be cultivated. But assuredly among your men of wealth there are those willing to listen to an appeal on higher grounds, to whom, as American citizens, it will be a pride to fashion American men so as to enable them to take their places among those great ones mentioned in my lectures. Into this plea I would pour all my strength. Not as a servant of Mammon do I ask you to take science to your hearts, but as the strengthener and enlightener of the mind of man.

"Might I now address a word or two to those who in the ardour of youth feel themselves drawn toward science as a vocation. They must, if possible, increase their fidelity to original research, prizing far more than the possession of wealth an honourable standing in science. They must, I think, be prepared at times to suffer a little for the sake of scientific righteousness, not refusing, should occasion demand it, to live low and lie hard to achieve the object of their lives. I do not here urge anything upon others that I should have been unwilling to do myself when young. Let me give you a line of personal history. In 1848, wishing to improve myself in science, I went to the University of Marburg—the same old town in which my great namesake, when even poorer than myself, published his translation of the Bible. I lodged in the plainest manner, in a street which, perhaps, bore an appropriate name while I dwelt upon it. It was called the *Ketserbach*—the heretic's brook—from a little historic rivulet running through it. I wished to keep myself clean and hardy; so I purchased a cask and had it cut in two by a carpenter. Half that cask, filled with spring water over night, was placed in my small bedroom, and never during the years that I spent there, in winter or in summer, did the clock of the beautiful Elizabethekirche, which was close at hand, finish striking the hour of six in the morning before I was in my tub. For a good portion of the time I rose an hour and a half earlier than this, working by lamp-light at the differential calculus when the world was slumbering round me. And I risked this breach in my pursuits and this expenditure of time and money, not because I had any definite prospect of material profit in view, but because I thought the cultivation of the intellect important— because, moreover, I loved my work, and entertained the sure and certain hope that, armed with knowledge, one can successfully fight one's way through the world. It is with the view of giving others the chance that I then enjoyed that I propose to devote the surplus of the money which you have so generously poured in upon me, to the education of young philosophers in Germany. I ought not, for their sake, to omit one additional motive by which I was upheld at the time here referred to—that was a sense of duty. Every young man of high aims must, I think, have a spice of this principle within him. There are sure to be hours in his life when his outlook will be dark, his work difficult, and his intellectual future uncertain. Over such periods, when the stimulus of success is absent, he must be carried by his sense of duty. It may not be so quick an incentive as glory, but it is a nobler one, and gives a tone to character which glory cannot impart. That unflinching devotion to work, without which no real eminence in science is now attainable, implies the writing at certain times of the stern resolve upon the student's character: 'I work not because I like to work, but because I ought to work.' In science, however, love and duty are sure to be rendered identical in the end."

THE TROGLODYTES OF THE VEZERE[*]

I HAVE come to speak to you about the Troglodytes of the Vezère, of that fossil population whose subterranean dwellings we are about to visit.

Their existence dates back to a startling antiquity. We do not know their name; no historian has mentioned them, not a vestige of them had been discovered until the last eight years; and yet they are better known to us, in many respects, than certain nations celebrated in classical history. We know their mode of life, their industry, their arts, and all the details of their existence. Is not this the true history of races, a history far more interesting than that of their battles, their conquests, and even their dynasties? How can we know so much of a people who have left no trace in the memory of man, and whose very existence would have been declared impossible twenty years ago? Are they the creatures of a dream, like the celebrated Troglodytes of Montesquieu? No. Nothing is more real than our Troglodytes; nothing more authentic than their annals. In the caverns which they inhabited, in those in which they laid their dead, have been found fragments of their meals, productions of their industry and arts, and remains of their bones. It is in this book that their history has been read; it is with these documents that their past existence has been resuscitated.

Many *savants* have taken part in these researches. Among others, Christy, the Marquis de Vibraye, M. Falconer, and our two colleagues, MM. Louis Lartet and Elie Massénat, deserve honourable mention; but there is one name that eclipses all the others, it is that of the founder of human palæontology—Edward Lartet.

I.—*Determining the Epoch*

Before speaking about a people it is well to assign it a place in time. But in this instance ordinary chronology is inapplicable. We are touching on periods of an incalculable length. Since the epoch when our Troglodytes lived, the climate and fauna have undergone considerable modifications, which have been produced slowly, without any revolution, without violent action, under the influence of those imperceptible causes which are still at work in our own day; and when we consider that, during the course of centuries of known time, these causes have only produced scarcely appreciable changes in our surroundings, we can have some idea of the prodigious duration of what is styled a geological epoch. These immense periods can neither be measured by years, by centuries, nor by thousands of years; these dates cannot be expressed in numbers, but we can determine the order in which the geological epochs followed each other, and the periods of which each is composed. These are the dates of the history of our planet; and the elements of what Edward Lartet has designated *palæontological chronology*. It will suffice for us to determine our dates from the commencement of the *quaternary epoch*.

The end of the tertiary epoch had been signalised by a remarkable phenomenon, of which the cause is not yet perfectly known. The northern hemisphere had gradually become colder. Immense blocks of ice, descending from the sides of the mountains into the valleys and plains, had covered a considerable portion of Europe, Asia, and North America; and the temperature of our zone, till then torrid, had by degrees become frigid. The duration of this cold period, called the *glacial period*, was excessively long. After having attained their farthest limits, the glaciers retired considerably, then they advanced again, but without regaining their former position. This was the last phase of the tertiary epoch. The glacial period was nearly at an end. A gradual modification of temperature caused the melting of the ice, and the quaternary epoch commenced. The glaciers, those immense masses of snow, hardened by time and accumulated during thousands of ages, produced, when they melted, gigantic torrents, sweeping along in their powerful waves the ruins of mountains, flooding the plains, ploughing up the soil, hollowing the valleys and leaving in their track large deposits of sand, pebbles, and argile. From that epoch, called the *diluvian*, are dated our present rivers, but they give us in these days but a faint idea of what they were then.

The extraordinary power of the water floods was above all remarkable during the early part of the quaternary epoch; it gradually decreased from that time, but it was not until the glaciers had retired within their original bounds, until the temperature had become nearly equal to that of our own day, that the phenomenon of the great inundations ceased, and that the quaternary epoch drew to a close. Since that time, we still find sand and pebbles displaced, and sometimes even masses of more or less volume torn from the sides of the valleys by the torrents, but the rivers and streams no longer bear along with them more than particles of clay and slime, and these deposits have formed alluvial soil. The whole period which has elapsed since the close of the quaternary epoch bears the name of *present epoch*, and the soil which has been formed in this period is called *recent soil*. It is, certainly, recent, if we compare it with the quaternary soil, but not with reference to our ordinary chronology, for several hundreds of ages must necessarily have elapsed during its formation.

These considerations will aid us in comprehending the most essential facts which have served to establish the dates of human palæontology. These dates are determined in the first place by pure geology, in the second by palæontology, and in the third by prehistoric archæology.

The geological dates are chiefly inscribed in the valleys and in the plains, where the great floods of the quaternary epoch have left deposits in the shape of layers more or less regularly stratified. Except where some event has disturbed or excavated the soil, the layers are superposed in order of antiquity. The oldest are found beneath and are called low level; above them are ranged the middle level, which succeed them, and which are, in their turn, covered by the layers of the upper level, dating from the latter part of the quaternary epoch. We find a layer more or less thick of recent soil, formed of accretions, turf, vegetable matter, &c., covering almost all the quaternary soil.

It must suffice to explain in a general way how the study of the stratification of the layers, termed stratigraphy, enables us to determine the relative age of the recent or quaternary deposits. This primary classification is purely geological. Thanks to the data which it furnishes, we can calculate the period of existence of those animals whose bones are found in the different layers; these animals in their turn serve to characterise periods, and can thus establish the dates of certain soils, or of those partial deposits which do not form a part of a complete and regular stratification.

I. Among the animals living in our land at the beginning of the quaternary epoch, some, like the mammoth, no longer exist save in a fossil state; these are the extinct animals; others, like the reindeer, have disappeared from our climate, but still live in other regions; these are the emigrant animals; others, like the horse, have survived to this day in our land, these are the existing animals.

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[*] Being the substance of the Address of M. Paul Broca to the French Association for the Advancement of Science, at the Session held at Bordeaux.

The extinct animals abounded in the earlier quaternary age. Several were large and powerful mammalia, carrying terrible weapons of their own, and the human form looked weak and puny by their side. There were, among others, the great cave bear (*Ursus spelæus*), the great cave lion (*Felis spelæa*), the amphibious hippopotamus (*Hip. amphibius*), the rhinoceros with the expanded nostrils (*Rh. tichorhinus*), the ancient elephant (*Elephas antiquus*), finally and above all the giant, and we may say the king of this fauna, the mammoth (*Elephas primigenius*).

It would be superfluous to enumerate the other *extinct* species which lived at the same epoch. The reindeer and several animals, now *emigrants* like itself, were also to be found in this fauna, but they were still rare; and a good number of existing species had already made their appearance.

It is with good cause that the first period of the quaternary epoch, that which corresponds with the low level of the valleys has been called *the mammoth age.*

Every condition favourable to the prosperity of this species was then combined. But changes supervened which, in the long run, were to lead to its decay. The temperature had become less rigorous, and a great number of herbivora, till then stunted in their development by the inclemency of the atmosphere, had been able to improve and increase.

Already the mammoth saw arrayed against him the power of man, who, under this somewhat modified climate, could join in bands sufficiently formidable to declare war against him. Finally, and above all, this same climate, which suited his enemies and his rivals, had become hurtful to his own organisation, which required a colder temperature. The mammoth, therefore, so common in the earlier quaternary period, began to decline. We are inclined to think his existence was prolonged to the end of the palæontological age; but long ere that he had ceased to reign.

II. There was thus, in the middle of the quaternary epoch, an *intermediate age*, corresponding to the middle level of the valleys: an age in which several species contemporary with the mammoth were already extinct, in which others, represented only by solitary specimens, were on the point of disappearing, while those species were on the other hand flourishing, which were better adapted to the changing atmospheric conditions. Among these latter, the reindeer (*Cervus tarandus*) already occupied an important place, but it was in the succeeding period that it flourished.

III. This intermediate age gave way by degrees to the third and last stage of the quaternary epoch. When the layers of the upper level began to be formed, the species which we call extinct had almost entirely disappeared. A few rare mammoths still survived. Still more rare were the gigantic Irish deer (*Megaceros hibernicus*) and the great lion of the caverns. The rest of the fauna had but slightly changed, but the reindeer had multiplied to a wonderful extent. It formed at that time the chief nourishment of man. The third period of the quaternary epoch is therefore deservedly styled the Reindeer age.

The difference in the fauna of those days from that of our own time did not alone consist in the presence of the reindeer; many other hardy species, to whom a cold climate was necessary and a temperate one injurious, were still existing in our as yet frigid zone. When the state of the atmosphere more nearly approached that of the present day, there was a disappearance of the individuals which represented these species in our hills and plains; but the species themselves did not on that account perish. In the colder regions whither they had wandered they found a more congenial air, and they have thus been enabled to perpetuate themselves to the present time.

IV. The disappearance of the reindeer and of the other emigrant species marked the end of the quaternary epoch and of the palæontological age. Then began the modern epoch. Our climate was probably still a little colder than it is in our own days, but it was already temperate, and the slight changes which it has since undergone have not affected the conditions of life to such a degree as to endanger the existence of species. If the urus (*Bos primigenius*) and the aurochs (*Bison Europæus*) have disappeared from our land, we must attribute these results more to the destructive action of man than to that of climate,* and to man is also attributed the introduction of several new species, for the most part domestic animals. With these few exceptions, we may say that from the end of the quaternary epoch our fauna has not changed, and that the recent soil only contains existing species.

The dates which we seek to establish are therefore determined at the same time by stratification and palæontology. They also rest on data of another order, and these constitute a real science, namely prehistoric archæology.

The point which is certain and which has been irrevocably proved by Boucher de Perthes, is that the most ancient beds of the quaternary epoch contain vestiges of human industry. The knowledge of metals only dates, one may say, from yesterday; before possessing these powerful auxiliaries, man was not unarmed. In the manufacture of his weapons and tools he had employed several hard substances, the bones, the teeth of large animals, the horns of the Ruminantia, but above all, stone, and more particularly flint; hence the name *Stone age*, given in the history of man to all the period which preceded the use of metals.

This stone age still continues among some savage nations, and it only came to an end among the civilised people of antiquity at an epoch very little anterior to the historic age. Hence it embraces nearly the whole duration of human existence. Now the mode of fabricating weapons, their shape, their nature, must necessarily have varied during this immense period, according to the changes in the wants, the mode of life, and the social state of man who employed them; and if we now consider that hard stones will last an indefinite time in the ground, we shall understand that the tokens of this primitive industry constitute indelible medals and chronological documents of the highest importance.

The dates established by prehistoric archæology agree pretty well, and sometimes coincide in a remarkable manner with those of palæontology and stratification,

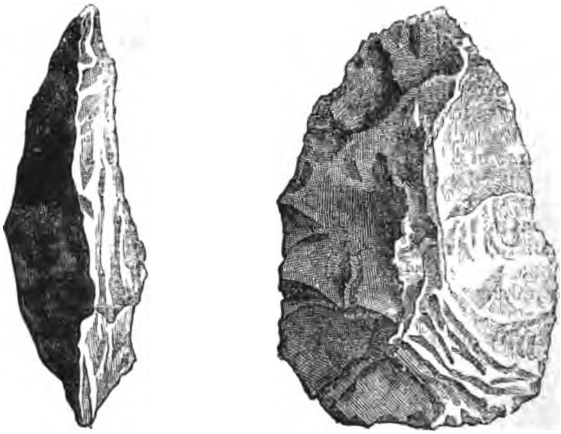

FIG. 2. FIG. 1.

The type of Saint Acheul: Hatchet carved on both sides. Fig. 1.—Front view. Fig. 2.—Edge view.

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* The urus is now extinct, but it is not more than three or four centuries since it existed in Germany and Great Britain. The aurochs is only to be found now in a forest of Lithuania, under the protection of a special law of the Russian Empire. A troop of them has been also seen in the Caucasus

Just as certain species of animals have perpetuated themselves since the earliest quaternary epoch, in like manner certain forms of hewn flint have been found almost without change through several archæological ages.

You have just seen that geologists have been able, more than once, to determine and designate an entire fauna from a single characteristic specimen; archæologists, in like manner, have chosen in each case the most characteristic tool to distinguish the different periods of the Stone age. We cannot strictly determine these periods and their precise number, for working in flint may have had many modifications at the same epoch, but in different localities. However, in studying the question in its entirety, we may, following M. de Mortillet's example, reduce to three the number of archæological periods of the quaternary epoch.

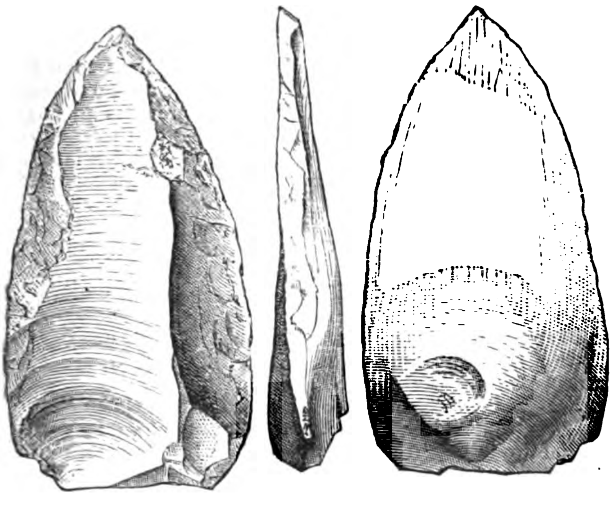

FIG. 4. FIG. 5 FIG. 3.

The Moustier type: Lance Point carved on one side. Fig. 3.—The plain side, cut out with one stroke; the projection of the bulb of percussion is visible at the base. Fig. 4.—The carved side. Fig. 5.—Edge view.

I. The most remarkable type of the early quaternary age is the hatchet of St. Acheul (see Figs. 1 and 2). It is a flint of varying bulk, always rather large, longer than it is wide, thick in the centre, graduated towards the edges, presenting one extremity pointed, or rather arched, while the other is rather rounded; and the predominant characteristic is its being carved on both sides, and the sides are more or less convex and more or less symmetrical. This type abounds at St. Acheul, near Amiens, in the valley of the Somme, hence its name; but it has been found in most of the beds of the Mammoth Age. It is sometimes, but rarely, to be met with in less ancient beds.

II. A second epoch of the Stone Age is characterised by the point of Moustier (see Figs. 3, 4, and 5). This weapon, which was fixed to the end of a huge lance, presents an exterior contour not dissimilar to that of the hatchet of St. Acheul, unless, perhaps, in being slightly more pointed; but its distinguishing mark lies in its being carved on one side only; the other side is cut out with one stroke, and has not been retouched. It is not therefore biconvex, like the other, but planoconvex, and consequently half the thickness.

The Moustier type takes its name from the Moustier Cave, where it is very common. It was not common until the intermediate period.

III. The art of cutting flint was perfected in a third epoch, which corresponds with the Reindeer Age. The pointed or sharp-edged weapons became less massive; the contours and sides were more regular, more symmetrical, and a delicate touching up, in fine little strokes, graduated them towards the edges. This period of the Stone Age is less marked by the nature of the weapons than by the style of workmanship. It is, however, agreed to take as a type the lance point of Solutré, because a short time since the lances found at the station of Solutré, in Maçonnais, were the best-cut weapons that had been extracted from the quaternary beds (see Fig. 6); but, since then, Dr. Jules Parrot, and his brother M. Philippe Parrot, have found at Saint Martin d'Excideuil (Dordogne), in a cave of the Reindeer Age, several flints carved in a yet superior style.

IV. We have now arrived at the end of the Reindeer Age. Directly the present epoch opens upon us, we see apparent in the flint cutting a further improvement, which marks the commencement of a new archæological era. Up to this time the flint had only been fashioned by pressure or percussion. They had learnt, it is true, to round by friction some objects in stone in a very rough style, but the weapons and tools in flint were always hewn. In the new era now commencing, many weapons were still made of cut flints; but from that time forth they knew how to polish them, and the polished hatchet, too well known to need description, became man's principal auxiliary (see Fig. 7).

This hatchet characterises the epoch of polished stone, or the neolithic epoch, which terminates the age of stone, and which, consequently, lasts until the introduction of metals. The entire period preceding the appearance of the polished hatchet constitutes the epoch of hewn stone, which is also called the archæolithic epoch, or better still palæolithic.

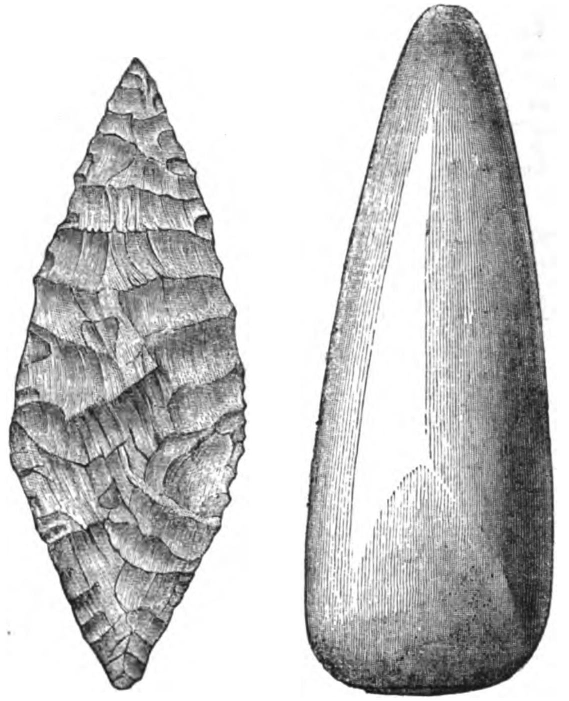

FIG. 6. FIG. 7.

FIG. 6.—The type of Solutré: Lance Point of Solutré (Hamy. Human Palæontology). Fig. 7.—The Polished Hatchet.

The different phases of the epoch of hewn stone succeeded each other progressively, and by almost imperceptible transitions, like the corresponding geological periods; the epoch of polished stone, on the contrary, stands out clearly and almost abruptly from that which preceded it. Its commencement coincides exactly with the disappearance of the reindeer, that is, with the end of the palæontological age, and with the commencement of the present epoch of geologists. It likewise coincides with a complete change in the social condition of man, with the domestication of the dog, with pastoral life, marked by the domestication of several herbivora, and soon after with agriculture. A long succession of ages then elapsed, until the appearance of bronze, which put an end to the Stone Age. The epoch of polished stone was therefore a very long one; compared to this the whole period of historic time sinks into insignificance: nevertheless, this period of polished stone, however long it may appear to us, was infinitely shorter than any of those of which the epoch of hewn stone is composed.

(*To be continued.*)

THE ITALIAN REPORT UPON THE ECLIPSE OF 1870[*]

THIS is a folio volume about an inch thick, in a yellow paper cover. It is a well-printed book, made of tolerably good foolscap, and as the title-page informs us, produced at the expense of the Italian Government, under the care of Prof. Sir G. Hunter, as we should call him, but in his native tongue, Il Cavaliere Professore G. Cacciatore[†]; and the first remark that occurs to one on looking through it is that whether the Government paid handsomely, or whether it gave with a grudging stinginess, its cash was at all events well laid out, alike without extravagance and without meanness, and that the result reflects honour upon Italy.

On dipping into its contents here and there in a cursory way, the next thing you notice is the eager interest which the several contributors seem to take in their work, and the earnest simplicity with which they recount their experiences and achievements.

Speaking generally, the volume is a picture-book; the plates, some of them distributed through the letterpress, but accumulated in a considerable mass at the end, form an important feature of it, and will be found very interesting and suggestive even to those who are not so fortunate as to read the text.

For the convenience of the latter class of persons, I propose now to give a slight sketch of the report, beginning at the preface, and describing the several papers in the order in which they occur; and if, whilst doing so, I should venture to make any comments, the reader must remember not to attach too much weight to them, because it is hardly possible for a foreigner to do justice to men whose words and ways must always bear from his point of view something of the interest proper to pictures by the old masters. I ought not to presume to review this book critically, because, in the first place, the chief performers concerned in it are in every way my superiors; and in the second place, I am obliged to confess at once that they are personally so vividly present in my memory, that it seems almost a rudeness to analyse their writing for public uses.

I find it impossible to eliminate the romantic charm of their manners, and my own recollections of the high courtesy they showed towards us when we were associated with them in Sicily.

A slight reflection of this latter will be perceived by the reader the first time he opens the book. Fronting the title-page he will find a lithographed drawing of the station at Augusta, purporting to show the several observatories, in which those of the Italian astronomers are shown in the background; whilst the rough shed of the English observers, and the tents in which they were encamped, form the most prominent features of the picture. In passing from this first page of the volume, I must testify to the singular faithfulness of the drawing.

After the title-page there occurs a short paragraph, consisting of Prof. Cacciatore's apology for the delay in the production of the Report. (By the way, I wonder what our unfortunate editor will say in this respect when, after we are all dead and turned to dust, he produces at his own untold expense the English report of the same eclipse as an astronomical curiosity! Is not that a rather pathetic and suggestive reflection?)

Next follows the index, and then an address to the Minister of Public Instruction, from which it appears that a royal decree of July 5 of the year previous to the eclipse appointed a Commission consisting of Professors Cacciatore, De Gasparis, Donati, Santini, and Schiaparelli "to draw up a programme of the observatories, and to appoint the persons, the instruments, and whatever might be considered necessary to the success of the enterprise"; and of this Commission, Prof. Santini of Padua. was appointed president, and Prof. Cacciatore, of Palermo, vice-president. This address is signed by Santini, and recounts further how the Commission assembled in Florence in September 1869, and added to its numbers Professors Padre Secchi and Pietro Blaserna, of which, and of all its other proceedings, the Minister had been kept informed. Santini goes on to say that his present duty is to express the thanks that Science owes to that official for the eagerness he showed in backing them up with a considerable augmentation of the fund originally appropriated, and getting placed at their disposal a Royal steamship, and so on.

He then says that, owing to his advanced age, the chief burden of the work fell to the lot of Cacciatore, and that, thanks to his careful diligence, and so on, things were got ready nearly as intended; the "nearly" being a consequence of the extraordinary political changes of the preceding year. Cacciatore however seems to have found it no joke, and the part confided to him, he says, was very arduous and rugged ("ben ardua e scabrosa").

Here follows Cacciatore's account (*relazione*) of all that he did, and it forms, perhaps, the most interesting chapter of the whole book. The rest of the observers pass before the reader in single file, each relating what he saw and did, in his own words; but Cacciatore gives us a peep behind the scenes, and tells us what was done in the way of preliminary arrangement, and how he tried to aid every man in the manner best calculated to develope his own particular abilities; and in these operations (if I may be allowed to pass a remark) he appears to have done his work in a masterly way; and he relates the story with a graceful facility that makes it most attractive reading. He describes his preliminary canter over the course of the totality in search of a suitable site for the observatories; tells how he first examined the neighbourhoods of Villa 'Smunda and Terranova, as affording beyond all doubt the most favourable conditions, and how he afterwards reluctantly abandoned the former on account of its unhealthiness, and fell back on Augusta for his chief station, the fortress of which he describes, and says he found it admirably adapted for the purpose. Most truly it was so; and if I were to give an account of it, I should find Cacciatore's allowance of adjectives very inadequate to convey my impression of its attractions, although December was by no means the month in which they could be fairly appreciated.

Leaving his colleague, Tacchini, there to make preparations, he returned to his observatory at Palermo, which formed the base of operations. After this he gives a summary of the instruments, the observers, and the *role* assigned to each, and tells how he marshalled them in two complete and independent divisions, one of them destined for Augusta and the other for Terranova. On November 25 the steamer *Plebiscito* cast anchor at Palermo, having picked up on her way from Genoa certain members of the expedition, with their instruments, and on the 27th they got under weigh again and proceeded to the east coast of the island, where they admired the scenery, and where their otherwise considerate and polite captain, Il Cavaliere Foscolo, strangely neglected the opportunity of running them ashore.[*]

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[*] Raporti sulle osservazioni dell'Eclisse totale di Sole del 22 Dicembre, 1870, eseguite in Sicilia dalla commissione Italiana.

[†] He always signs himself G. Cacciatore, but his first name is Gaetano.

Arriving thus at their citadel, nearly a month in advance, and finding that ample preparations had already been made, they were now in a position to devote themselves quietly to their own particular pursuits, and to carry on their experiments with reference to the important occasion. However, they were no sooner comfortably settled than their troubles began, somewhat after the fashion of Job's—"a great wind from the wilderness smote the four corners" of the fortress, and threatened to leave poor Cacciatore alone to tell the tale; and he seems to have had to put up with not a little "chaff" from his comforters as to his selection of a site; but he consoles himself with the thought that it would have been all the same if he had settled anywhere else.

Then follows a little paragraph about the English, which I may as wall translate:—"Meantime the most enlightened Prof. Adams, together with several of the numerous English Commission—others having remained in Catania—escaped from the misfortune of the *Psyche*, a magnificent steamer of the British Navy, stranded amongst the coasts of Acireale, arrived in Augusta for the observation of the phenomenon. Colonel Porter, of the Engineers, accompanied by soldiers of the same arm, having preceded them, visited our temporary establishment, passed graceful encomiums on the organisation, and planted tents and barracks (huts) at the foot of our fortress, and at the extremity of the open space which divided it from the town. With these distinguished gentlemen we maintained such friendly and cordial relations as are becoming between the citizens of cultivated and free nations."

The incidents of the three or four days preceding the eclipse, and the anxieties caused by the weather, are told with a graphic vividness that will cause those of us who were there to live over again through that period of painful suspense, a suspense only less felt by the English because of the demands made on their energies by the hurry and hard work of preparation. For we had to do in a five days' encampment in a foreign country what they very reasonably employed more than a month to do in their own. After describing the fitful changes of the wind, clouds, and barometer, which kept them oscillating between hope and dread up to the very beginning of the eclipse, he says: "And just then the sun appeared radiant and luminous, so as to provoke a cry of joy from as many as stood intent to observe him. So it went on until the moment of totality; but then some clouds began to traverse the obscured disc, and so rapid was their movement and their succession one after another, that they influenced the degree of visibility to each one of the observers in a different sense, and in such a fashion that there were some of them more fortunate and others less so." This admirably careful description corresponds perfectly with our own experience, and should be duly taken into account when the value of the observations comes to be considered. Cacciatore's own estimate of the work done, an estimate formed on the spot immediately after the eclipse, when he came to review his company, is expressed in reserved and general terms as follows:—"I was able to satisfy myself that alhough the sky was not largely propitious, it nevertheless conceded to us a certain interval, the fruits of which had been reaped to the utmost; and that if in general the observations of the eclipse of 1870 turned out unfortunate, the Augusta division would be able to supply facts which would not be without importance in the present state of science."

He then proceeds to summarise the results as follows:—

"Padre Secchi had assumed the photographic department, and the spectroscopic determination of the protuberances previous to the eclipse, with the view of being able to compare them with those which should be seen during the totality. The position and the shape of these were obtained on the morning of the same day, favoured by a fine serene sky. Ten photographs were made during the phases, and at the moment of totality photographs of the protuberances were obtained, in spite of the obstacle of a cloud. At the same time their forms were directly noted, and immediately afterwards were confronted with the spectroscopic figures. The spectrum of the most acute cusps of the sun was studied, and photographs of the later phases were taken until the end of the eclipse.

"Prof. Denza made spectroscopic observations of the corona, which discovered two bright lines, one near the E, the other probably of nitrogen (*dell' azoto*). Together with Signor De Lisa they observed and drew the protuberances.

"Prof. Donati in the time of totality was able to see the bright lines of one protuberance already studied before the eclipse. He saw the lines of hydrogen and one line in the yellow more refrangible than the sodium, but did not see any of the iron lines.

"Prof. Blaserna examined whether the corona contained polarised light. Employing a Savart polariscope applied to a refracting telescope of moderate magnifying power, he was able to examine three points situated at 45° from each other. The polarisation was most pronounced, and very nearly of the same intensity as the atmospheric polarisation seen recently on clear days at about 50° from the sun. At the distance of a degree and a half from the moon not a trace of polarisation was seen, the influence of the air, therefore, in the observed phenomenon remains eliminated. The plane of polarisation was found in all the points radial or tangential to the sun's limb. It remains then established that the corona is polarised, and hence contains reflected light sent out from the photosphere.

"The purely astronomical part assigned to me (the director) was, as far as the variable condition of the heavens admitted, fulfilled to the best of my ability. I was able, in fact, to note with some precision the instants of first contact, and the beginning of totality and the end of it (although the last through the clouds), besides some other observations which I shall refer to afterwards."

This summary concludes with a mention of the magnetic and meteorological observations, and the Professor goes on to remark concerning the station at Terranova, that the circumstances there were not dissimilar to those at Augusta—the same strong wind and clouds interfered as at the latter place.

Thus ends the general account of the operations described by the leader of the expedition—a most interesting introduction, and well worthy of the seven independent papers from Augusta which follow it, to which are added about the same number from Terranova, and some dozen more abridged accounts by outsiders, which form an appendix.

The leading place is accorded to that most accomplished of ecclesiastics, Father Secchi, who, in his ringing and trenchant style, gives a vivid picture of the whole experience, from the ordering of the instruments to the ultimate effect of the phenomenon. Next follows Donati, "in a speech curt tuscan, sober, expurgate, spare of an 'issimo,'" as Robert Browning says, in which the blunt but attractive manners of that genial soul are nearly as appreciable by the reader as if he were present in the flesh. After him Cacciatore details his own observations in his gracefully fluent yet finished style, and then come Blaserna's polariscopic experiments, clearly and energetically expressed, and, as far as I can judge, affording most conclusive results. It is not a little remarkable how much is contributed towards the value of the observations by the manner in which each observer relates them. The descriptions are given with such charming naïveté and absence of affectation, that the reader can appreciate almost the exact degree in which the writer's hand shook as he manipulated his instrument, not to speak of the degree in which his assertions can be relied upon for accuracy or freedom from bias.

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[*] When it came to the knowledge of this gentleman (through the ever attentive Secchi) that our military escort, in consequence of "superior orders," had taken away our tents, and left us without shelter upon the open glacis at Augusta, he sent us a polite message, placing his ship at our service in the handsomest manner.

JOHN BRETT

NOTES

M. JANSSEN has been elected a member of the Astronomical Section of the French Academy, the votes recorded for him being 42, against 13 for M. Loewy, and 1 for M. Wolff.

AT a recent meeting of the Natural Science Section of the Literary and Philosophical Society of Sheffield, a discussion took place on "The Attitude of the State to Science," in which Dr. Hime, Mr. Alfred H. Allen, Mr. H. C. Sorby, F.R.S., and Mr. J. Spear Parker successively took part, and the opinion of the meeting was embodied in the following resolution, which was passed unanimously:—"That this meeting deplores the supineness of the Government with respect to science, and believes that the national recognition of research, and the establishment of better means of rewarding discoverers, would be a direct benefit to the country."

IN order to remove any apprehension that might arise in the minds of some members of the Anthropological Institute (particularly of those residing in the country), from statements made that, in consequence of the recent change in the composition of the Council, a preference would be given to papers of an ethnographical class over those relating to other branches of anthropology, the director, with the full concurrence of the president, has thought it advisable to assure the members of the Institute that no such result need be feared. Papers on every branch of anthropology will always be cordially received, provided they comply with the requirements demanded in all communications to a Scientific Society intended for publication, amongst which, a very essential one is, that they should contain either "new facts or new applications of admitted facts." As a further assurance that all proper subjects will receive due and equal attention, it may be well to state in general terms what may be regarded as proper subjects to be brought before the Anthropological Institute. They may be included under the following heads:—(1) The Physical History of Man and of the Human Race; (2) Psychology; (3) Comparative Philology; (4) Priscan Archæology, *a* Prehistoric, *b* Protohistoric; (5) Descriptive Ethnography, comprising the Reports of Travellers and Explorers on the Physical Characters, Derivation and Relation, Manners, Customs, Religion, Language, &c., of various Races or Nations; (6) Comparative Ethnography; (7) The Relations between Civilised Man and Aboriginal Savage Peoples. In this programme it will be seen that any subject properly coming under the cognizance of the anthropologist may find a place. And in order to insure confidence that each and every subject will receive due attention, it is suggested that committees might, if thought desirable, be formed of such members of the institute as may take a special interest in any of the above branches of inquiry, whose function would be, each in its own sphere, to promote the collection of materials and the production of papers relating to the subject in which they may feel particular interest. In this way it is clear that all the subjects will be placed on an equality, and to be hoped that each in its turn will receive the same attention.

SOME weeks ago we expressed a hope that the vacant Swiney Lectureship would not be given to one who is already well off, but to some well-qualified young man, who would thus have leisure to perform work of high scientific value. Our hope, we are glad to see, has been essentially fulfilled in the appointment of Dr. Carpenter, who, unusually young in spirit, assuredly deserves the leisure which this appointment will ultimately help to bring him, leisure which, we have good reason to believe, will be devoted to the completion of work of very high scientific value indeed. Few men have devoted gratuitously more of their time to the public benefit, and we believe that he accepts the appointment mainly in order that he may have a good opportunity of working out in fuller detail the applications to geology of the inquiries in which he has been engaged during the last few years. Dr. Carpenter, we understand, has had by him for years, the material, fully worked out, of important papers which he has had no time to produce. Dr. Carpenter has once before held the Swiney Lectureship, and it has been offered to him again without any solicitation on his part.

ON Monday last, in the first of his Hunterian lectures for this year, Prof. Flower drew special attention to the peculiarities of a new animal discovered by Prof. Marsh, of Yale College, and named by him *Dinoceras mirabilis*. This remarkable ungulate, nearly the size of the elephant, was obtained from the Eocene beds of the Rocky Mountain region. It possessed osseous cores for three pairs of horns, which rise successively one above the other; a supra occipital crest is greatly developed, projecting obliquely backward beyond the condyles. The posterior pair of horns arise from this crest, the median from the maxillaries, and the anterior from the tips of the nasals. The canines are greatly developed, and the upper incisors are wanting. The skull is unusually long and narrow, and carries six small molar and premolar teeth. The extremities resembled very nearly those in the proboscidia, but were proportionately shorter. The femur possessed no third trochanter and no pit for the ligamentum teres. It therefore possesses characters allying it with the perissodactyles as well as the proscidia.

PROF. MARSH has also drawn attention to a new sub-class of fossil birds from the cretaceous shales of Kansas. The specimens, while possessing the scapular arch, wing, and leg-bones of the truly orthnithic type, present the very aberrant conditions of having biconcave vertebræ and well developed teeth in both jaws. These teeth are quite numerous and implanted in distinct sockets; the twenty in each ramus of the lower jaw are inclined backwards and resemble one another. The maxillary teeth are equally numerous and like those in the mandible. The sternum have a carina and elongated articulations for the coracoids. The lower of the posterior extremities resemble those of swimming birds. The last sacral vertebra is large, so it may have carried a tail. Professor Marsh proposes the name *Odontornithes* for the name of the new sub-class, and *Ichthyonithes* for the order to contain this remarkable species, which is about the size of a pigeon.

AT a meeting of the Senate of the University of London held last week, a resolution was passed by a majority of two, that it is desirable to make Greek an optional subject at the Matriculation Examination. The practical effect of the carrying out of this regulation will be, that while those who are intending to proceed to degrees in Arts will continue to take Greek at the matriculation, as a matter of course, it will not be required from those who are going on to degrees in Science or Medicine.

MR. A. W. BENNETT, M.A., B.Sc., F.L.S., has been elected Lecturer in Botany at St. Thomas's Hospital School of Medicine, in the place of the Rev. J. W. Hicks. A vacancy is thus caused in the Lectureship on Botany at the Westminster Hospita School.

THE following new candidates for the Professorship of Geology at Cambridge are announced:—Mr. William King, Professor of Mineralogy and Geology, Queen's College, Galway; and Mr. P. Brodie, M.A., F.G.S., of Emmanuel College, and Vicar of Rowington.

THE office of Chief Assistant in the Observatory, Cape of Good Hope, will be filled up by open competition on March 18 next, and the following days. Candidates must be between eighteen and twenty-five years of age, and the salary commences at 320*l.*, rising 10*l.* a year to 450*l.*

WE are really sorry to hear that the much-talked-of Arctic expedition of M. Pavy, who was recently fabled to have discovered an Arctic Continent, has vanished into worse than "thin air." It is perhaps unprecedented in the annals of science that the funds meant to be devoted to a noble and heroic purpose, should be literally wasted in riotous living. We hear, on too good authority, alas, that M. Pavy's explorations have been confined to certain not unknown phases of "life" in San Francisco.

COAL has been discovered on the railway from Mollendo to Arequipa in Peru. The seam is four yards thick. The coal has been reported as of good quality, and it is already being used on the railway.

DR. REISS, one of two German travellers in Ecuador, has succeeded not only in ascending Sotopax, but in entering the crater.

A GERMAN from Berlin has been for some time at Panama butterfly hunting. His first remittance was one hundred pounds' worth of butterflies.

ON December 28, 1872, a slight shock of earthquake was felt at Goalpara in Northern India, and again on January 3.

ON December 28, 1872, a strong earthquake was felt at 10 A.M., doing much damage at Chinameca, Salvador, Central America. It is attributed to the volcano of San Vicente, now in eruption.

ON January 1 there was a slight shock of earthquake at Guayaquil.

THE *Times of India* reports a sharp shock of earthquake which was felt on January 7, about 4 P.M., at the camp between Sultanpore and Fyzabad, in Oudh.

THE great shock of earthquake in Samos on January 31 happened at 1.10 A.M., and lasted 10 seconds. Several houses were thrown down, and many damaged.

THE French authorities at Tahiti report in their official journal that, in consequence of changes in the coast line and reefs, new rules for navigation have been issued. They announce, also, that the island placed in 21° 50′ S., and 152° 20″ W., does not exist, as the place has been sailed over by three vessels. Captain Truxton, of the U.S. ship *T. Jamestown*, has informed them that he has passed over the position of a reef assigned to 24° 45′ S. and 150° 40′ W., without seeing any token of danger.

M. DE FONVIELLE has been authorised by the French Academy to make a series of experiments on a new lightning conductor which he has devised.

THE Report of the Marlborough College Natural History Society for the half year ending Christmas, 1872, contains much that is of considerable interest and value, though we are sorry to see from the very honest preface, that the Society is not in so satisfactory a condition as it ought to and might be. While admitting that a fair amount of work has been done, the preface complains of the lack of interest in the work of the Society, and the comparatively small amount of energy displayed by many of the members. With regard to nearly all the sections, the tone of the preface is desponding, though hopeful that a change for the better may take place next year. The Society contains some excellent workers, who have shown no disposition to relax their efforts, and we earnestly hope that their example will be largely contagious, and that the next report will be written in a very different tone. It is a pity that a society so favourably situated in many respects as this is should not produce more abundant and more valuable results. The geological section, we are sorry to see, is nowhere, mainly for want of a permanent head. The society is also very much cramped for want of a suitable building for the museum. We hope this report will stimulate all the members to renewed activity; let them take to heart the very excellent advice given in the paper on "An Ideal School Natural History Society," by Mr. E. F. im Thurm, who deserves great praise for his efforts on behalf of the society. Appended are reports of the out-door work done in entomology and botany during the half year, and a long and very interesting paper by the Rev. J. A. Preston, describing what he saw on a recent visit to Brazil. The concluding article of the Report is Part I. of a carefully compiled descriptive Catalogue of the Archæological Collection of the Society, by Mr. F. E. Hulme, which is accompanied with a beautifully executed illustration of some of the articles in the collection.

AT the first meeting of the Sheffield Naturalists' Club held a few days ago, Mr. H. C. Sorby, the president, delivered a very excellent inaugural address, in which he gave his views as to the objects of the formation of such a society. Such a society as this, he said, had two characters. First of all, the subjective influence it had on the members who composed it. The study of natural history was most desirable in many ways. Man had a certain amount of energy; it must be expended in some way or other, and the examination into natural history furnished them with a study which was advantageous to both body and mind. By being joined together in a society they might greatly help one another. With regard to the objective value of such a society as this, he thought they ought not to limit their efforts to the mere making out of accurate lists of flora and fauna which occurred in the district. The efforts of naturalists also ought to be devoted to the discovery of general philosophical principles, as applied to both animals and plants. He thought they could learn a great deal more by the careful study of the commonest things than by looking for rarities. They could not hesitate in saying that a great deal remained to be done in the study of natural history in every district. The following, he thought, were some of the points which such a society should inquire into:—What is life, and how have the various species of animals and plants originated? Why do particular plants grow in particular localities? The determination of that question would have a most important bearing on geological theores. Another problem for study was what was the effect of dry or wet seasons on certain plants? If that question were settled, they might know the effect that must have been produced in bygone ages—by the alteration of climate—on certain plants and animals. Another most interesting subject for investigation was the influence of plants on plants, animals on animals, and one on the other; the fertilisation of plants by insects, and the attractability of different colours for different insects. Other points recommended for study were the following:—The manner in which the habits of animals have been acquired; the manner in which varieties or species have been formed; the limit of the successive generation of insects through none but females; the diseases of plants due to parasitic fungi and insects.

THE first number of Petermann's *Mittheilungen* contains a brief account of the eruption of a new volcano in Chili, which occurred during part of last June and July. The volcano, known by the name of Lhagnell, is situated in the south of the country, in Arauco, between the volcanoes Villarico and Llaima, near the river Cautin. Immense quantities of sand seem to have been thrown out, some of which, according to Dr. Philippi, of Santiago, reached a distance of 300 or 400 miles north from the volcano. This sand is described as consisting of angular, transparent green particles of volcanic glass. Dr. Philippi also reports that for fourteen days, about midday, a strong south wind blew, as far north as Santiago, small quantities of sand, much coarser than the above, with rounded corners, opaque and grey. Great quantities of lava, according to the report of a spectator, have overflowed the district, causing considerable destruction to life, and stopping up the river Quepe, which is thus being converted into a considerable lake.

WE have received a small pamphlet, by Mr. B. H. Babbage, containing a description of a portion of the late Mr. C. Babbage's calculating machine or difference engine, put together in 1833, and now being exhibited in the educational division of the South Kensington Museum.

La Revue Scientifique for February 15, gives a summary of the much needed administrative reforms which have been introduced into the Collége de France.

WE have received the following papers recently read before the Eastbourne Natural History Society:—"On *Geoglossum difforme* or Earth-tongue," by Mr. C. J. Muller; "A Note on the Wall Pelletory," by Mr. F. C. S. Roper; "On the Planet Venus," by Mr. T. Ryle.

THE principal articles in the *Quarterly Journal of Science* are:—"On the Probability of Error in Experimental Research," by Mr. Crookes; "Condition of the Moon's surface," by Mr. R. A. Proctor, with photograph; "Colours and their Relations," by Mr. Mungo Ponton; and "Remarks on the Present State of the Devonian Question," by Mr. H. B. Woodward.

THE *Annual of the Royal School of Naval Architecture*, &c., contains some good technical papers. This publication will become vastly increased in importance, and we hope in value, by the establishment of the new school at Greenwich.

WE take the following from the *Engineer*:—The question as to whether a gasometer will explode when fired was settled in Manchester on Tuesday, February 11, when one of the gasometers at the Manchester Corporation Gasworks in Rochdale-road was destroyed by fire. The origin of the fire is not known, but about 2 o'clock a workman saw flames issuing from one end of the gasometers, and the flames could not be checked till the whole contents of the gasometer, about 600,000 cubic feet of gas, had been consumed. Many inhabitants of the neighbourhood hurried away with loads of their furniture, fearing an explosion, but nothing of the kind occurred.

ADVICES from Cyprus state that no rain had fallen on the island for months; but this is probably an exaggeration.

WE learn from the *Athenæum* that the Rev. Thomas Hincks, F.R.S., is now engaged in preparing a "History of the British Polyzoa."

PROFESSOR RAMSAY ON LAKES

PROF. RAMSAY, F.R.S., delivered a course of six lectures to working men, on Monday evenings, commencing Jan. 5, 1873, in the Lecture Theatre of the Geological Museum. The subject of the course was "Lakes, fresh and salt: their origin, and distribution in geographical space and in geological time," and the following is an abstract of them:—

I. FRESHWATER LAKES, THEIR ORIGIN AND GEOGRAPHICAL DISTRIBUTION

There are many classes of lakes in the world, formed in various ways, and though he had been unjustly charged with ascribing all lakes to one origin, he would be the last person to do so. He then went on to examine the various means which might be supposed to produce lake basins, and especially that class of lakes scattered over the whole northern hemisphere—in Wales, Cumberland, Scotland, Sweden and Norway, Russia and N. America—the basins of which had evidently been formed by the erosion and grinding out of portions of the earth's crust. In many cases these lakes are in true rock basins, surrounded by lips of rock. How were these hollows produced by Nature? The dislocations of the earth's crust could not produce them; as a rule the sides of faults are close together or the fissure is filled up with other matter, and the depressions due to synclinal curves were never so simple or perfect as these lake basins, owing to violent disturbances, and to subsequent denudation. The theory of a special area of subsidence for each lake seems absurd, on considering the vast numbers of separate lakes, in N. America for example, lying in some case within a mile or two of each other. Again, a lake cannot make its own hollow; what little motion there is in the water can only affect the waste of the shores. Neither can a river scoop out a lake hollow, it can only produce a long narrow channel, and go on widening and deepening that, and the sediment which it carries down into the lake will in the long run fill up the lake basin. The action of the sea, too, on its shores cannot scoop out a lake hollow, it can merely wear back its cliffs and form a "plain of marine denudation" just below the level of its waters. And thus having exhausted all the other natural agencies which effect the denudation of the land, what agency remains to us to account for the formations of these lake basins, but the grinding power of ice? The lecturer then adverted to the phenomena of the formation and progress of glaciers, illustrating his remarks by diagrams of the great Rhone glacier. In the Alpine valleys there are numerous indications—in the mammellated surface of the rocks, the striation, moraines, and boulders—that at some period in the past all these glaciers had been very much more extensive than at present, and were found in many parts where now they are altogether wanting. In Greenland the whole country is covered by a universal ice sheet, which extends into the sea in some cases several miles, and where cliffs of ice rise out of the sea 200 to 300 ft. high, and, as recent soundings have shown, are sometimes 3,000 ft. deep. Large masses of these breaking off float away as icebergs, bearing with them stones and rubbish which they deposit, on melting, irregularly over the sea bottom. In the mountains of Wales and Scotland, in the Vosges, the Black Forest range, and in N. America are numerous signs of glacier action, all which prove that at one period, recent in a geological sense, glaciers were present in those districts; and boulders and boulder clay deposits show also that the Northern part of the Northern hemisphere was passing through a glacial epoch.

Boulder clay and moraines have sometimes dammed up a stream of water aud formed a lake, but lakes of that kind are neither numerous nor of much importance. The theory that the true rock basins were scooped out by glaciers first occurred to the lecturer whilst observing in N. Wales, and he applied it first to the explanation of the tarns about Snowdon, but extended observation of the Italian and other great lakes, and subsequently of the American lakes, warranted him in applying it to them also. He had especially applied it to the Lake of Geneva, which lies directly in the course of the old Rhone glacier. The lake is 983 ft. in depth in its deepest part, nearly in the centre. Where the glacier entered the lake it could not have been less than 3,000 ft. thick, and as the rock underneath is comparatively of a soft character, where the ice was thickest the grinding power was greatest, and it scooped out its deepest hollow; but towards the south end the mass had grown less through melting, and the result was a shallowing of the basin It is in the valleys of Switzerland down which the glaciers must formerly have extended that the lakes lie. The great depth of Lake Maggiore beneath the sea-level—2,300 ft.—is no argument against the theory, for a large mass of ice would block out the sea-waters. In Wales the lakes are never of large size, Lake Bala, the largest, being about 4½ miles long; Lake Windermere lies in a true rock basin, as do many others in that district; in Scotland, where the climate was more severe, the lakes are larger and more numerous; in Sweden and Norway, in Finland and N. Russia the lakes are almost innumerable, while in N. America they are scattered almost broadcast over the country N. of lat. 43°. Where the glacial action was most intense, there the lakes become more and more numerous, and he believed they were due not to special glaciers, like those on the south side of the Alps, but to that great ice sheet which, according to Agassiz, covered the whole country. In South America and New Zealand, too, are signs of a similar action, and there too, lakes of this class occur. The present glaciers of New Zealand are very small compared with what they evidently were at a previous period, and in the course of every one of them are lakes, which, according to reports he had received, also lie in true rock basins.

II. Salt Water Lakes, their Origin and Geographical Distribution

The lecturer said that he could not account for the origin of all salt-water lakes, but for some of them the evidence is clear, and it is plain to see why they are salt. The principal minerals forming the rocks of the earth's crust are silica, alumina, lime, potash, soda, magnesia, peroxide of iron, &c. Rain-water takes up from the atmosphere and the earth's surface a small proportion of carbonic acid, and thus acquires the power of dissolving certain of these minerals as it percolates through the rocks, notably lime, which it carries away in the form of a bi-carbonate. And thus the water of all springs is charged more or less with mineral ingredients, though these may be recognisable only by the skill of the chemist. Thus the water of the fountains in Trafalgar Square contain 69·75 grains of salts per gallon, including chloride of sodium 25·7; bi-carbonate of soda 14·5; sulphate of soda 18·4. The Thames water at Teddington contains 22·5 grains per gallon, and thus carries to the sea in the course of a year 377,000 tons of salts; the old well at Bath holds 144 grains of salts per gallon, thus bringing to the surface 608 tons of salts per year. The apparently small quantity of bi-carbonate of lime in a per-centage of the salts of sea-water, is still sufficient to furnish to marine creatures materials for their shells and skeletons, and thus indirectly to build up the great beds of limestone which are now in course of formation, or belong to former geological periods. The analyses of salts in sea-water and in the water of various lakes is given in the following table:

Per centage of	Mediterranean Sea.	Black Sea.	Sea of Azof.	Caspian Sea.	Dead Sea.
Chloride of Sodium.....	2·9460	1·4020	0·9658	0·3673	12·110
,, Magnesium	0·3223	0·1304	0·0887	0·0632	7·822
,, Calcium.....	—	—	—	—	2·455
,, Potash.......	0·0505	0·0189	0·0128	0·0076	1·217
Bromide of Magnesium	—	0·0005	0·0004	trace	
Sulphate of Lime	0·1357	0·0105	0·0288	0·0490	0·452
,, Magnesium	0·2480	0·1470	0·0764	0·1239	
Bromide of Sodium	0·0558	—	—	—	
Carbonate of Lime......	0·0113	0·0359	0·0022	0·0171	
,, Magnesia	—	0·0209	0·0129	0·0013	
Peroxide of Iron.........	0·0004	—	—	—	
	3·7700	1·7661	1·1880	0·6294	24·056

Salt lakes though not so numerous as fresh-water lakes, occur in large numbers in certain regions. The Caspian Sea with an area as large as Spain, the Sea of Aral, and a vast number among the mountains and table-lands north of the Himalaya; the Dead Sea in Syria; L. Utah, and neighbouring lakes among the mountains on the western side of North America; and among the mountains of South America and in the interior of Australia are examples of large salt water lakes. It will be noticed that all these lakes lie in an area of inland drainage, that they have rivers running into them, but that they have no outlet. On inspecting the above table it will be seen that the Black Sea is fresher than the Mediterranean, by reason of the greater supply of fresh water furnished by the rivers, and Edward Forbes showed that this freshening has caused certain of the shells of Mediterranean species to assume "monstrous" shapes. The Caspian is still fresher, and its fauna and fossils in recent deposits in the neighbourhood prove it to have once had connection with the Black Sea, from which it has been separated by changes in physical geography; it was then salter than at present, but is now growing salter again every year, and the fauna now inhabiting its waters have likewise considerable affinities with North Sea types. Its surface level is 83·5 ft. below that of the Black Sea, while the surface of the Dead Sea is 1300 ft. below that of the Mediterranean. In all cases where rivers flow into depressions in the land, however these might have been formed (oscillating movements of the earth's crust might perhaps form such large ones as the Caspian basin), carrying with them certain salts in solution, if the lake have no outflowing river, the water must be carried away by evaporation, in which case the salts will be left behind, and the remaining waters become more and more saturated. It is stated that crystals of salt have been brought up from the Dead Sea, and on the shallow waters on its coasts evaporating in summer saline incrustations are left. The same water which flows *through* the Sea of Galilee, a fresh-water lake, renders the Dead Sea one of the most remarkable salt lakes in the world. And in this and all similar cases accumulation of salts will go on till the saturation point is reached, and then precipitation will commence. The region to the north of the Himalayas is comparatively rainless, owing to the mountains condensing the moisture carried by the south winds, and the rivers consequently do not carry into the lakes sufficient water to make them overflow their boundaries, hence they are salt. Lake Baikal, with an outlet to the sea, is quite fresh. For a similar reason the moisture from the south-west winds being condensed in great part by the Sierra Nevada, the lakes which lie in the great plains and table-lands to the east of that range have not a sufficient supply of water to cause them to overflow, and consequently they are salt, and are continually becoming salter. In 100 parts by weight of the water of the Great Salt Lake in that region, there are of chloride of sodium (common salt) 20·196; sulphate of soda 1·834; chloride of magnesia 0·252; chloride of calcium a trace, making a total of 22·282. And by means of the old water levels in the form of terraces round its margin, it can be proved that it has shrunk very considerably, and therefore its salts must be becoming very much concentrated. On the surrounding plains a saline efflorescence is found, which the lecturer believed might be explained by the rain which saturated the rocks during the rainy season rising again to the surface charged with salts dissolved from the rocks, during the intense heats of summer.

(*To be continued*).

SCIENTIFIC SERIALS

The *Zoologist* for January and February contains reviews of the works of Capt. Shelley and the late C. J. Andersson. Dr. Gray contributes a paper on the Cetacea of the British Seas, and Mr. Harting has a supplement to his paper on the British Heronries, a subject on which there are several letters also published. Messrs. Stevenson and J. H. Gurney, jun., send Ornithological notes from Norfolk, and Messrs. Gatcombe and Cordeux from Devon and Lincolnshire respectively.

The *Entomologist* for January and February, among other articles of interest, contains one by Mr. H. C. Lord, on "The Lepidoptera of Switzerland," as far as could be obtained in a twelve days stay. Out of the sixty-three species of butterflies met with, twenty-four are not British. Many of the English commonest forms are among the most frequently found there. *Colias Hyale* is commoner in some parts than *C. Edusa*, and *C. Helice* is not unfrequently found. Mr. F. Walker continues his papers on "Economy of Chalcidiæ."

SOCIETIES AND ACADEMIES

London

Royal Society, Jan. 9.—"On a new Method of viewing the Chromosphere," by J. N. Lockyer, F.R.S., and G. M. Seabroke.

The observations made by slitless spectroscopes during the eclipse of December 11, 1871, led one of us early this year to the conclusion that the most convenient and labour-saving contrivance for the daily observation of the chromosphere would be to photograph daily the image of a ring-slit, which should be coincident with an image of the chromosphere itself.

The same idea has since occurred to the other.

We therefore beg leave to send in a joint communication to the Royal Society on the subject, showing the manner in which this kind of observation can be carried out, remarking that, although the method still requires some instrumental details, which will make its working more perfect, images of the chromosphere, almost in its entirety, have already been seen on several days during the present month and the latter part of last month.

The adaptation of this method to a telespectroscope will be seen at a glance from the accompanying drawing.

The image of the sun is brought to focus on a diaphragm having a circular disc of brass (in the centre) of the same size as the sun's image, so that the sun's light is obstructed and the chromospheric light is allowed to pass. The chromosphere is afterwards brought to a focus again at the position usually occupied by the slit of the spectroscope; and in the eye-piece is seen the chromosphere in circles corresponding to the "C" or other lines. The lens D is used to reduce the size of the sun's image, and keep it of the same size as the diaphragm at different times of the year; and the lenses F are used in order to reduce the size of the annulus of light to about ⅛ inch, so that the pencils of light from either side of the annulus may not be too divergent to pass through the prisms at the same time, and that the image of the whole annulus may be seen at once. There are mechanical difficulties in producing a perfect annulus of the required size, so one ½ inch in diameter is used, and can be reduced virtually to any size at pleasure.

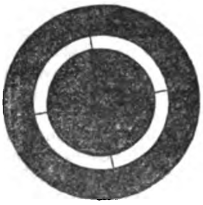


FIG. 1.

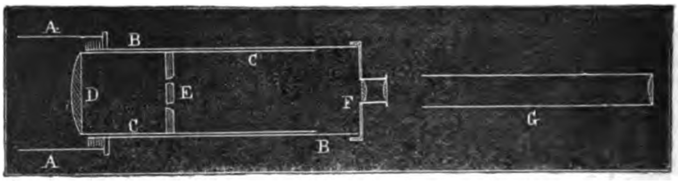


FIG. 2.

Fig. 1.—Diaphragm showing annulus, the breadth of which may be varied to suit the state of the air. The annulus is viewed and brought to focus by looking through apertures in the side of the tubes.—Fig. 2. A. Sliding eye-tube of telescope. B. Tube screwing into eye-tube. C. Tube sliding inside B, and carrying lens D and diaphragm E. F. Lenses bringing image of diaphragm to a focus at the place generally occupied by the slit of the spectroscope. G. Collimator of spectroscope.

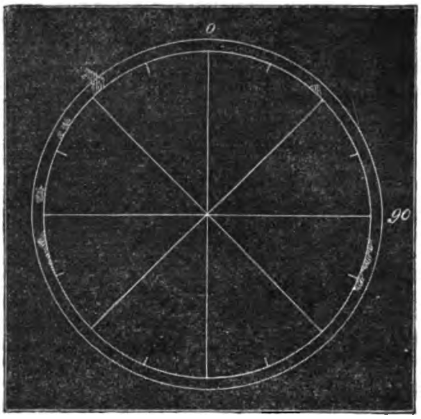
The proposed photographic arrangements are as follows:

A large Steinheil spectroscope is used, its usual slit being replaced by the ring one.

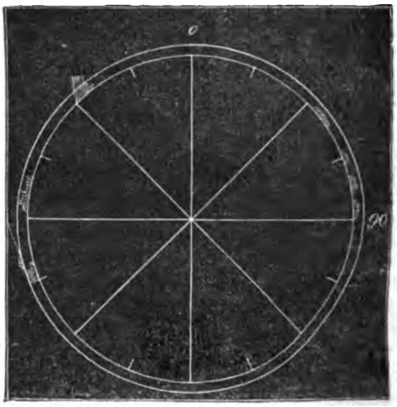
A solar beam is thrown along the axis of the collimator by a heliostat, and the sun's image is brought to focus on the ring-slit by a 3¾-inch object-glass, the solar image being made to fit the slit by a suitable lens.

By this method the image of the chromosphere received on the photographic plate can be obtained of a convenient size, as a telescope of any dimensions may be used for focussing the parallel beam which passes through the prisms on to the plate.

December 6, 1872, at 11.30.



December 7, 1872, at 11.30.



Outer circle 100 sec. from inner one. Chromosphere at normal height, except where prominences marked.

The size of the image of the chromosphere obtained by the method adopted will be seen from the accompanying photograph, taken when the ring-slit was illuminated with the vapours of copper and cadmium.

As this photograph is not reproduced, it may be stated that the ring-images have an internal diameter of nearly ¾ of an inch.

The accompanying solar profiles are copies of drawing made, on the dates stated, by means of the new method, which were exhibited by the authors at the meeting.

[Since reading the above paper it has come to our knowledge that Zöllner had conceived the same idea unknown to us, but had rejected it. Prof. Wenlock in America has tried a similar arrangement, but without success.—J.N.L., G.M.S., January 17, 1873.]

Feb. 13.—"On a new Relation between Heat and Electricity," by Frederick Guthrie.

It is found that the reaction between an electrified body and a neighbouring neutral one, whereby the eletricity in the neutral body is inductively decomposed and attraction produced, undergoes a modification when the neutral body is considerably heated.

Under many circumstances it is found that the electrified body is rapidly and completely discharged. The action of discharge is shown to depend mainly upon the following conditions:—(1) The temperature of the discharging body and its distance from the electrified one. (2) The nature (+ or −) of the latter's electricity.

With regard to (1), it is shown that the discharging power of a hot body diminishes with its distance and increases with its temperature. But, concerning the temperature, it is proved that the discharging power of a hot body does not depend upon the quantity of heat radiated from it to the electrified body, but chiefly upon its quality. Thus a white hot platinum wire connected with the earth may exercise an indefinitely greater discharging power, at the same distance, than a large mass of iron at 100° C., though the latter may impart more heat to the electrified body.

Neither the mere reception of heat, however intense, by the electrified body, unless the latter have such small capacity as to be itself intensely heated, discharges the electricity if the source of heat be distant: nor is discharge effected when the electrified body and a neighbouring cold one are surrounded by air through which intense heat is passing. But, for the discharge, it is necessary that heat of intensity pass to the electrified body from a neutral body, within inductive range.

White- and red-hot metallic neutral bodies exercise this discharging power even when isolated from the earth, but always with less facility than when earth-connected.

The hotter the discharging body, whether isolated or earth-connected, the more nearly alike do + or – electricities behave in being discharged; but at certain temperatures distinct differences are noticed. The — electricity, in all cases of difference, is discharged with greater facility than the +.

Attempts are made to measure the critical temperatures at which earth-connected hot iron (1) discharges + and — electricity with nearly the same facility, (2) begins, as it cools, to show a preferential power of discharging —, and (3) ceases to discharge —. The temperatures so obtained are measured by the number of heat-units, measured from 0° C. in 1 grm. of iron of the respective temperature, represented by the value of the expression $Fe\ \Sigma_0 u$.

It is shown that various flames, both earth-connected and isolated, have an exceedingly great power of discharging both kinds of electricity.

The effects in regard to discharge are shown to be similar when platinum wire, rendered hot by a galvanic current, is used, and also when the condensed electricity of a Leyden jar is experimented on.

As hot iron shows a preferential power of discharging — over + electricity, so it is found that white-hot but isolated iron refuses to be charged either with + or — electricity. As the iron cools it acquires first the power of receiving — and afterwards of receiving +. Further, while white-hot iron in contact with an electrified body prevents that body from retaining a charge of either kind of electricity, as it cools it permits a + charge to be received, and subsequently a — one.

A suggestion is made as to the existence of an electrical coercitive force, the presence of which, together with its diminution by heat would explain much of what has been described.

"On Curvature and Orthogonal Surfaces." By A. Cayley, F.R.S., Sadlerian Professor of Mathematics in the University of Cambridge.

Entomological Society.—February 3.—H. W. Bates, vice-president, in the chair.—Mr. F. Smith exhibited a box of Hymenoptera, collected near Calcutta, containing, amongst other insects, a new species of *Astata*, and four or five beautiful species of the genus *Nomia*.—Mr. McLachlan exhibited a quadrangular case formed by the larva of a trichopterous insect, taken by the Rev. A. E. Eaton in the river Dove in Derbyshire.—Mr. Champion exhibited specimens of a large species of *Pulex* found in a mouse's nest in Sheppy.—Mr. Meldola exhibited a living specimen of a myriapod of the genus *Spirobolus*, sent to him from San Francisco. Also eggs of a leaf insect from Java (*Phyllium pulchrifolium*).—Mr. Müller made remarks on pouch galls found on the leaves of cinnamon from Bombay.—Rev. Mr. Eaton read a paper on the *Hydroptilidæ*, a trichopterous family.—Mr. A. G. Butler communicated a monograph of the genus *Gasteracantha*, or crab-spiders.

Royal Microscopical Society, Feb. 5, Anniversary Meeting.—W. Kitchen Parker, F.R.S., in the chair. The report and treasurer's statement of account having been presented the president read a highly interesting address descriptive of his own further researches upon cranial development, which, during the year, had been chiefly confined to the formation of the skull of the pig. He briefly indicated the methods adopted, and some of the results obtained, and concluded by expressing the opinion that what he had already observed led him to conclude that if all existing forms had been really derived from one, the process must have been slow indeed. The report having been adopted, and some discussion having taken place as to the society's position, cordial votes of thanks to the retiring president, hon. secretary, and to the other officers of the society for their services during the past year were unanimously carried. The following is a list of the officers and council for the ensuing year:—President—Charles Brooke, M.A., F.R.S. Vice-Presidents—William B. Carpenter, M.D., F.R.S.; Sir John Lubbock, Bart., M.P., F.R.S.; William Kitchen Parker, F.R.S.; Francis H. Wenham, C.E. Treasurer—John Ware Stephenson, F.R.A.S. Secretaries—Henry J. Slack, F.G.S.; Charles Stewart, F.L.S. Council—James Bell, F.C.S.; John Berney; Robert Braithwaite, M.D., F.L.S.; William J. Gray, M.D.; Henry Lawson, M.D.; Benjamin T. Lowne, F.L.S.; Samuel J. McIntire; John Millar, F.L.S.; Henry Périgal, F.R.A.S.; Alfred Sanders; Charles Tyler, F.L.S.; Thomas C. White. Assistant Secretary—Walter W. Reeves.

MANCHESTER

Literary and Philosophical Society, Feb. 4.—Dr. J. P. Joule, F.R.S., &c., president, in the chair. E. W. Binney, F.R.S., paid a warm tribute to the memory of one of the most illustrious honorary members of the Society, the late Professor Sedgwick.—Prof. Williamson, F.R.S., stated that the second fossil plant described by Mr. Binney at the last meeting of the Society, Jan. 21, and of which a notice appeared in the Society's Proceedings, does not belong to some new genus, as Mr. Binney supposed, but is one that he has already described on two or three occasions as being the stem or branch of the well-known genus *Asterophyllites*. The author said that he had obtained the plant in almost every stage of its growth, from the youngest twig to the more matured stem, and that the genus would be the subject of his next, or fifth, of the series of memoirs now in course of publication by the Royal Society.—"On a large meteor seen on Feb. 3, 1873, at 10 P.M.," by Prof. Osborne Reynolds,[*] On Feb. 3, at 10h. 7m. (as afterwards appeared) by my watch (which was 7 minutes fast), I was walking from Manchester along the east side of the Oxford Road (which there runs 30° to the east of south), I had just reached the corner of Grafton-street, when I saw a most brilliant meteor. I first became aware of it from the brightness of the wall on my left, *i.e.*, on the north-east, which caused me to turn my head in that the wrong direction; the first effect was that of a flash of lightning, but it continued and increased until it was equal to daylight. On lifting my head I saw directly in front of me, what had previously been hidden by the brim of my hat, a bright object, apparently fixed in the sky, as though it were coming directly towards me; immediately afterwards it turned to the west, and passed just under the moon (which it completely outshone). I was very much startled when I first caught sight of it, owing doubtless to the rapidity with which it was increasing in size, and the directness with which it seemed to be coming. The next instant I saw that it was only an extraordinary meteor. It passed the moon, falling at an angle of, I should say, 20°, and then ceased suddenly, having traversed a path of about 90°, from the south to the east. The colour of the light was that of a blue light, or rather burning magnesium. The sky was cloudy, but there was no appearance of redness about either the head or the train. I endeavoured to fix its course by the stars, but it was too cloudy, although I could see here and there a star. The conclusions I came to, there and then, were that its course must have been nearly parallel with the road, which by the map runs, at that point, 30° to the west of north; that when I first saw it it was about 40° above the horizon and due south; and that it passed about 20° to the north of the moon. (This would make its line of approach from Pegasus.) While I was thinking of its course I heard a report, not very loud, but which I connected with it. I judged it was about 30s after the display. I then looked at may watch; it was 10h. 7m. I then walked along, talking to a fellow-traveller who had not quite recovered his alarm. Presently we heard a loud report, like a short peal of thunder or the firing of a large cannon; I immediately looked at my watch, it was then 10h. 10m., so that this second report was from three to four minutes after the display. I have no doubt that this was the report of the meteor, for compared with the other it was like the firing of a cannon to a musket. The time of the second report would make the distance 30 or 40 miles, so that it would have passed over Chester and burst over Liverpool. In this case it must have been a tremendous affair, for the sky was cloudy, and I do not think I exaggerate when I say that at one instant it was as light as day; the train was very long, and the speed great. It ceased suddenly, as when a ball from a Roman candle falls into water; there were no fragments, as from an explosion.—"Note on a Meta-Vanadic Acid," by Dr. B. W. Gerland.—Dr. Roberts spoke on the subject of Biogenesis. (See his letter in this week's NATURE).—P.S. To Dr. Joule's description of a Mercurial Air-Pump.—The exhauster described in the last number (p. 296) has been further improved by dispensing with the glass tube *e*, and its stop-cock *f*. This is effected by attaching the base of the globe *b* to a strengthened india-rubber pipe, connected at the other end to a glass vessel of rather larger capacity than *b*. This vessel has only to be successively raised and lowered in order to exhaust the receiver. The mercury in the vessel may be either under atmospheric pressure or relieved therefrom. In the former case it must be alternately raised and depressed from 30 inches below *b* up to that level. In the latter it must be raised and depressed from the level of *b* to 30 inches above it. Castor oil is a useful medium to prevent the passage of air between mercury and the glass vessels. It is important to add a little sulphuric acid to the mercury, in order to remove the film of water which adheres to the inside of the globe *b*. On this account it would, perhaps, be desirable to substitute a plug of glass for the indiarubber one between *a* and *b*.

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[*] See NATURE, Feb. 6, p. 262, and Feb. 13, p. 290.

PARIS

Academy of Sciences, Feb. 10.—M. de Quatrefages, president, in the chair. M. Faye read an answer to Fathers Secchi and Tacchini's criticism on his recent paper on the solar spots. With regard to the assertion of the former that the gyratory motion of solar cyclones must be small, he replied by proving that it must be at least five times that of the most violent terrestrial cyclones; he then proceeded to answer the other objections in detail, and quoted a recent letter from Mr. Norman Lockyer, in opposition to the Rev. Father's theory of the spots being eruptions. MM. Becquerel and E. Becquerel then read a note on the temperature of soils, bare, and covered with vegetation, during rainy seasons. The bare soils are always at a lower temperature.—M. Daubrée read a note on two meteorites which fell, one at Montlivant in 1838, and the other at Beust in 1859, and also a communication on a new arrangement of the meteorite collection in the Museum d'Histoire Naturelle.—M. des Cloiseaux read a note on the determination of the form of amblygonite crystals; and M. Trécul the third part of his paper on the carpellary theory of the *Papaveraceæ* (*Chelidonium Macleya*), and on the same subject as regards the *Fossiflora Laudoni*. These papers were followed by one by M. de Caligny on certain works used in canal navigation. Notes on vine sickness and Phylloxera were received from MM. Marès, de Luca, Fancon, Nourrigat, Jeanheury, and Madame Vivien Jaworsta. A letter from M. Is. Pierre on the density of absolutely pure alcohol was read.—M. Janssen was then elected to the astronomical section in succession to the late M. Laugier. Out of fifty-six votes he obtained forty-two, M. Loewy thirteen, and M. Wolff one. M. A. Cornu read a paper on a new determination of the velocity of light. His determinations agree well with those of Foucault.—A note on the electric resistance of metals was then read.—M. V. de Luynes sent a note on the annealing of glass.—MM. Rabuteau and Ducoudray one on the toxic properties of calcic salts. The authors state that metals are more poisonous as their atomic weights increase, and compare calcium with strontium and barium, both of which are poisonous to a considerable extent.—M. F. Papillon sent a second note on experimental researches on the modification of the composition of bone.—M. Champouillon one on the properties of silicate of soda, &c.—M. S. de Luca one on a stalagmitic body from the solfaterra of Pozzuoli.—Messrs. Lockyer and Seabroke sent a description of their method of observing the solar prominences with an annular slit; this was followed by a paper on the "Heat of Transformation," by M. J. Moutier; and one on the maximum resistance of galvanometers, by M. Th. du Moncel.—MM. Laussedat and Magnin sent a note on the use of the pocket aneroid and on a new hypsometric formula of great simplicity.—M. E. Bourgoin sent a paper on the action of bromine on di-bromosuccinic acid. The author has thus obtained a hydride of tetra-brominated ethylene.—M. F. Hamel sent a note on a new red colouring matter from aniline. The body in question is produced by acting on aniline with chloride of sulphur.—M. J. Carlet sent a description of a new osmometer.—M. Locari sent a paper on the presence of human bones in the osseous brecchia of Corsica; and M. E. T. Hamy one on the age of the fossil men of Guadeloup.—M. W. de Fonvielle sent a description of a new lightning conductor. The session then adjourned.

DIARY

THURSDAY, FEBRUARY 20.

ROYAL SOCIETY, at 8.30.—On the Anatomy and Histology of the Land Planarians of Ceylon: H. W. Moseley.—On a new Locality of Amblygonite, and on Montebrasite, a new Hydrated Aluminium and Lithium Phosphate: A. O. Des Cloizeaux.

SOCIETY OF ANTIQUARIES, at 8.30.—Memoir and Funeral Expenses of James Montagu, Bishop of Winchester, A.D. 1618: E. P. Shirley.

LINNEAN SOCIETY, at 8.

CHEMICAL SOCIETY, at 8.—On Aurin: R. S. Dale and Dr. C. Schorlemmer—Researches on the Action of the Copper-Zinc Couple on Organic Bodies.—I On Iodide of Ethyl: Dr Gladstone and A. Tribe.—Solidification of Nitrous Oxide: Mr. Wills.—Action of Hydrochloric Acid on Codeine: Dr. C. R. A. Wright.

NUMISMATIC SOCIETY, at 7.

ZOOLOGICAL SOCIETY, at 4.

FRIDAY, FEBRUARY 21.

GEOLOGICAL SOCIETY, at 8.—Anniversary.

ROYAL INSTITUTION, at 9.—Action at a Distance: Prof. Clerk Maxwell.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals (Hunterian Lectures): Prof. Flower.

OLD CHANGE MICROSCOPICAL SOCIETY, at 5.30.—On the Internal Economy of Insects: T. Rymer Jones.

SATURDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 3.—Comparative Politics: Dr. E. A. Freeman.

SUNDAY, FEBRUARY 23.

SUNDAY LECTURE SOCIETY, at 4.—The Skin; its Structure and Uses: A. Balmanno Squire.

MONDAY, FEBRUARY 24.

ROYAL GEOGRAPHICAL SOCIETY, at 8 30.—A Journey in Southern Formosa J. Thomson.—Notes on Badakhshan and Wakman: The President.

LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower

TUESDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, FEBRUARY 26.

LONDON INSTITUTION, at 7.—Lecture.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

SOCIETY OF ARTS, at 8.—Discussion on Lieut.-Col. A. Strange' Paper on "Ships for the Channel Passage."

GEOLOGICAL SOCIETY, at 8.—On the Jurassic Rocks of Skye and Raasay: Dr. James Bryce.—Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders: D. Mackintosh.—On the Origin of Clay-ironstone: J. Lucas.

ARCHÆOLOGICAL ASSOCIATION, at 8.

ROYAL SOCIETY OF LITERATURE, at 8.30.—Remarks on Early Monastic and other Seals attached to Charters in the Bodleian Library, Oxford: W. H. Turner.

THURSDAY, FEBRUARY 27.

ROYAL SOCIETY, at 8.30.

SOCIETY OF ANTIQUARIES, at 8.30

ROYAL INSTITUTION, at 3.—Artificial Formation of Organic Substances: Dr. Armstrong.

BOOKS RECEIVED

ENGLISH.—Elementary Anatomy: St. G. Mivart (Macmillan).—Caliban the Missing Link: Dr. Wilson (Macmillan).—Recent Discussions in Science, Philosophy, and Morals: new edition: H. Spencer.—Science Primer, No. 4. Physical Geography: A. Geikie (Macmillan).—Key to North American Birds: E. Coues (Trübner). Exalted state of the Nervous System: R. H. Collyer (Renshaw).

AMERICAN.—What am I? Vol. i.: E W. Cox (Appleton, New York).

FOREIGN.—Anwendung des Spectral appartus: Dr. K. Vurdott (Asher).

PAMPHLETS RECEIVED

ENGLISH.—Annual of the Royal School of Naval Architecture. No. 3. *Jan.* 1873.—Physical Condition of the Inland Seas.—Report of the Scientific Researches carried on during the months of Aug., Sept., Oct., 1871, in H.M. Surveying Ship *Shearwater*: W. B. Carpenter.—Science and Art Dept.: Babbage Calculating Machine.

FOREIGN.—Sitzung-Berichte Nat. Gel. Isis, Dresden, April to September 1872.

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ERRATA.—Vol. vii p. 280, 1st col. 3rd line from bottom, after *Myxospongiæ*, insert *and Hydrozoa*: p. 289, 1st col., line 17 from bottom, for *hematoids* read *Nematoids*: p. 289, 1st col., line 11 from bottom, for '175 read 4th: p. 291, 1st col. line 4 from top, for *leucocyles* read *leucocytes*.

THURSDAY, FEBRUARY 27, 1873

WESTERN YUNAN

A Report on the Expedition to Western Yunan, viâ Bhamô. By John Anderson, M.D. (Calcutta: Office of the Superintendent of Government Printing, 1871.)

THIS interesting volume consists of the first section of a report on the expedition from Burmah over the Chinese frontier into Yunan, sent out under the auspices of the British Government, in the year 1868. It was under the charge of Major Sladen and Captain Williams, with the author, Dr. Anderson, as naturalist to the Expedition. They were accompanied by Messrs. Bowers, Stewart, and Burn, as representatives of the commercial community at Rangoon; the main object in view being to ascertain how far it was possible for the great highway to China by the valley of the Tapeng, could be made open to British commerce. The desirability of this access to the western frontiers of China has long been felt, and many attempts have been made during the last two centuries to establish an emporium either at Bhamô or in its neighbourhood, and one of the results of the recent expedition has been the sanction on the part of the Burmese Government of the residence of a British representative at Bhamô for the protection of our commercial interests.

The first part of the volume before us is chiefly historical, and deals with the relations of the ancient Shan kingdom of Pong, with the neighbouring States of Burmah and China, and the wars which resulted in Pong becoming a Burmese province. The wars between China and Burmah are also described, but during the last hundred years or more the intercourse between the two nations has been one of peace.

The European intercourse with Bhamô is next traced from the days of Marco Polo downwards; for from some of the details given by that traveller as to the customs of the inhabitants of the province of Kardandan, there can be but little doubt that his route must in part at least have almost coincided with that of the expedition.

The description of the physical features and geology of the Bhamô district and of Western Yunan forms an interesting and important chapter. At Bhamô itself the Irawady, though 600 miles from the sea, is one and a half miles in breadth during the heavy rains, and about a mile during the dry season. Its great valley is, however, in places broken up by low isolated ranges which confine its waters to comparatively narrow but deep channels. These hill ranges are usually of metamorphic and crystalline rocks on which Eocene and Miocene strata, consisting of limestone, sandstone, clay, coal, and ferruginous conglomerates, have been deposited together with interbedded traps. The Tapeng, along the valley of which the course of the expedition lay, has a course of about 150 miles from its rise in the Kananzan hills to its confluence with the Irawady above Bhamô. For a considerable portion of this distance there is a continued succession of waterfalls and rapids, though it is navigable for about twenty miles when it reaches the Burmese plain. The Kakhyen hills through which it passes attain a height of 5,000 or 6,000 ft., and appear to be mainly composed of metamorphic and crystalline rocks. Their surface, even to the highest peaks, is strewn with water-worn boulders, to which Dr. Anderson assigns a marine origin, believing that since their deposit this tract of country has been raised from beneath the sea, and that the immense valley of the Irawady was subsequently excavated. The Kananzan range appears to attain an elevation of about 9,000 ft., and to consist of rocks of the same character.

The Nantin valley leading to Momien seems to belong to another geological age, as in that district there has been a comparatively recent outflow of trappean rocks, while the country to the west is exclusively granitic and metamorphic. There, as well as in the Sanda Valley, are hot springs which issue at almost the boiling-point, and at the head of the Nantin valley is the large extinct volcano of Hawshuenshan. An extremely interesting feature in this valley and lower down the stream in the Mawphoo gorge, consists in the well-marked river terraces. Two of these seem to extend the whole length of the valley of Nantin—about sixteen miles—and there are indications of a third at a still higher level.

Of the mineral products, the coal seems to hold out the promise of good fuel and in fair quantity. It crops out on the surface in several places on the right bank of the Irawady, but as yet has been but little worked. Its geological age has yet to be determined.

Galena, rich in silver, is found in the valley of the Tapeng, and gold also occurs, sometimes in grains as large as small peas. The most interesting products of this part of Burmah are, however, amber and jade. The amber mines are at an elevation of about 1,050 ft., in a low range of hills to the S.W. of the Meinkhoom plain, in the Hukong valley. It is procured in a primitive manner by digging holes about 3 ft. in diameter, and sometimes as much as 40 ft. in depth. "Fifteen to twenty feet of the superficial soil is clayey and red, but the remainder consists of a greyish black carbonaceous earth. Foliated limestone, serpentine, and coal, are among the other strata. The amber is found in both of the former, and its presence is indicated by small pieces of lignite which are easily detected." It is made into Buddhist rosaries, finger-rings, pipe mouth-pieces, &c. The dark sherry-coloured amber is most highly valued.

Jade is found in more or less rounded boulders embedded in a reddish yellow clay. Pits are sunk in search of it on no defined plan, and at certain seasons of the year there are as many as 1,000 men engaged in digging for jade in the Mogoung districts. Blocks are occasionally found so large that they require three men to turn them. Everything in connection with the trade is taxed—diggers, purchasers, jade, and even the ponies used for its transport—and the revenue from the mines was, in 1836, about 4,000*l.* The jade used to be largely worked at Momien, and the manufacture is still carried on there to some extent. It is cut by means of thin copper discs about eighteen inches in diameter, used in conjunction with fine siliceous grit, composed of quartz and little particles resembling ruby dust. The boring of ear-rings and bracelets is effected by a revolving cylinder tipped at the free end with the same siliceous mixture. The most valuable jade is of an intense bright green colour, but the red and pale pink varieties are also prized. A pair of bracelets of the finest jade costs about 10*l.* at Momien.

At some remote period the jade appears to have been applied to useful rather than to ornamental purposes, for celts formed of this material are found all over the district, lying on the surface soil, and doubtless turned up by the plough. They have also been formed of various other rocks, such as quartz, Lydian-stone, green-stone, clay-slate, &c. Lithographic plates are given of twenty-three of these instruments of various size, form, and material; but about 150 were procured by different members of the expedition. A good series of them has been presented to the Christy collection by Major Sladen.

A bronze celt, socketed, but without any side loop, and of peculiar form, with an oblique segmental cutting edge, was also procured. These are so highly valued that as much as 5*l.* apiece was asked for them. The composition, curiously enough, is identical with that usual in European antiquities of the same class, being 9 of copper to 1 of tin. The stone celts being more abundant than those in bronze, were less valued, being sold in the bazaars and elsewhere at from 4*d.* to 1*s.* 6*d.* each. Both they and the bronze celts are regarded as thunderbolts, which, after they fall and penetrate the earth, take nine years to work their way up to the surface. Not only is this belief in the celestial origin of these implements common to Asia and Europe, but the healing powers attributed to them in most European countries, are also accorded them in Yunan. They are worn as charms and carefully kept in small bags; and water, in which they have been placed, is administered as a medicine, especially in the case of tedious labour. It is rather a compliment to the students of prehistoric archæology that the only objects thought worthy of being figured by Dr. Anderson should be these celts.

The ethnological details given by the author as to the Shans, and what may be regarded as the transitional varieties between them and the Burmese on the one side, and the Chinese on the other, are highly interesting. A more barbarous people with whom the expedition was brought in contact, are Kakhyens or Chingpaws, who, though hemmed in on either side by Buddhist nations, still retain an ancient worship of good and evil spirits whom they call "nâts," and to whom they are constantly making propitiatory offerings of pigs, fowls, and rice.

Their method of producing fire is very remarkable, and is effected by "the sudden and forcible descent of a piston in a closed cylinder. There is a small cup-shaped cavity at the end of the piston rod, into which a little tinder is inserted. The piston is then introduced into the cylinder, which it tightly fits, and by a blow is made to descend with great rapidity and force, and is as rapidly withdrawn, when the little pellet of tinder is found to have become ignited." The instruments are not more than four inches long, and are in general use. It would be highly interesting to trace the origin and date of this invention.

At Bhamô one of the articles exposed for sale in the shops was flint, which would therefore appear to be the fire-producing material of the Burmese-Shans. Iron is abundant, and the Chinese-Shans, who resort annually to Bhamô for the purpose of manufacturing the dâhs or swords, are expert blacksmiths, their bellows consisting of a segment of bamboo with a piston, and a valve at each end.

Among some of the Shan tribes neck-rings or *torques*, curiously like those found in Western Europe, are still in use; but the majority of the ornaments appear to be Chinese in character. It would, however, extend this notice beyond all reasonable limits were an attempt made to give even a short abstract of the chapter on the Shans, Kakhyens and other races to the east of Bhamô. The curious practice of horse-worship in connection with the Buddhism of the Sanda Valley may, however, be noticed, as well as the Shan method of concealment of gold and precious stones, by burying them beneath the skin of their chest and necks by making slits, through which the coins or stones are forced, and which subsequently heal up. When the valuable object is wanted a second cut is made upon the spot, and it is extracted. In some instances, as many as fifteen stones or coins were found to be hidden beneath the skin of men just arrived with a caravan at Mandalay. It is needless to follow the author in his report on the Mahomedans in Yunan, the presence of whom, however, proved of great service to the expedition, as many of their guard were of that religion, and thus found friends. Nor need the trade routes of Upper Burmah be here discussed. The geographer will find much information in the chapter on the Irawady and its sources, and in the accompanying map. This chapter concludes the Report, and the remainder of the volume contains the diary of the author, written during the expedition. His report on the Natural History collections formed during his travels, has yet to appear, and will no doubt contain curious details. Even now we may call attention to the remarkable instance of the taming of fishes in a large river like the Irawady, by the phoongyees or Buddhist priests. At the boatman's cry of *tit, tit, tit*, numbers of fish came to be fed with rice and plantains, putting their heads above water, allowing themselves to be stroked, and even permitting Dr. Anderson to put his fist into their mouths so as to feel their teeth. He was unable to procure a specimen, as there were strict orders from the king that they should not be killed.

With this anecdote we must conclude our notice of this interesting Report, and must express a hope that a certain number of copies of it may be consigned to some London publisher so that it may become accessible to the general public, which as yet it apparently is not.

JOHN EVANS

THE HYGIENE OF AIR AND WATER

The Hygiene of Air and Water. Being a Popular Account of the Effects of the Impurities of Air and Water, their Detection, and the Modes of remedying them. By William Proctor, M.D., F.C.S., Surgeon to the York Dispensary, and formerly Lecturer on Chemistry and Forensic Medicine in the York School of Medicine. (Hardwicke.)

THIS is a useful little book, but it wants some revising: it is too sweeping a statement to say that the oxygen of the air is constant in amount and the carbonic acid variable; it is true that the variations in the amount of oxygen are very small in proportion to that amount. It would have been well to state even in a popular treatise that other substances besides ozone affect Schönbein's papers, which are not "browned" by the way.

We are glad to see that the organic impurities introduced into the air by the respiration of animals receive due attention, and that the gradual deterioration of health caused by breathing impure air is well insisted on.

The pages on the ventilation of sewers, &c., want rewriting, and the three conclusions all require alteration; they are as follows:—

1. "That no sewers, or drains, or pipes, should run into drains in dwelling houses." This sentence as it stands is too ambiguous to be of any value.

2. "If this be impracticable, all sink pipes or waste pipes should be broken off at least one foot above the trapped grating into which they discharge." The first clause here is unnecessary and even misleading; it would be well left out.

3. "On no account should a cesspool be placed within the walls of a dwelling, but as far as possible from the house." Surely it would have been well here to advise the abolition of these nuisances where not absolutely impracticable, or at any rate their construction of suitable impervious materials.

This is certainly the weakest part of the book, and shows how little such matters are generally understood even yet.

On the other hand the remarks on the relations of filth and disease are excellent: "the negligence of the upper and lower classes of society alike, in these matters, entails terrible calamities on both. The fevers and contagious disorders arising from the neglect of the poor, either on their own or on our part, find their way into the dwellings of all classes, and equally establish disease. The poorer class cannot with impunity live in a state of unnecessary filth and dirt; neither, on the other hand, may the rich without danger neglect the sanitary and physical conditions of the poor around them."

The currents of air produced in rooms by differences in the temperature of various parts should, if classed with winds (the aspirating effect of which latter is not mentioned), be at any rate in a separate subsection; and the law of diffusion of gases does not hold for vapours, and it is certainly not in virtue of it that "the dispersion of vaporous matter" in the air is effected. Otherwise the pages on ventilation are well worth study, and the same may be said of the part devoted to disinfectants, which contains much sound practical information.

The second part of the book, on "the impurities of water and their removal," is decidedly good; some of the best known cases illustrating the connection between polluted water and specimens of cholera and enteric fever are given, and the dangers to be apprehended from the habitual imbibition of impure water (apart from specific diseases) are insisted on; the presence of more than a small amount of chlorides is rightly pointed out as a suspicious circumstance, and the simpler tests for the detection of the various impurities are concisely described; then follows a short account of the methods to be employed for the purification of presumably impure water by means of boiling, filtration, &c., and several of the best household filters are mentioned. Clark's process is, however, only casually alluded to, and not by name.

We are glad to find that the importance of a *continuous water supply* especially to the poorer classes is pointed out.

The book before us will, with a small amount of correction, do valuable service if widely circulated, as we have little doubt that it will be. If we have drawn attention to a few defects in it, we have done so because we believe that it is of the utmost importance that popular manuals should contain exact information, and enter as little as possible into disputed points. W. H. C.

OUR BOOK SHELF

The Coal-fields of Great Britain, &c. By Edward Hull, M.A., F.R.S., &c. Third edition. (London: Stanford.)

THIS new edition of Prof. Hull's well-known work is in most respects a great improvement upon the previous ones. Not only are the coal-fields of Britain itself treated of in more detail, but those of the colonies and foreign countries also come in for fuller notice. The introduction of numerous excellent maps illustrative of the English coal-fields imparts an additional value to the volume, by enabling the reader to grasp at a glance the leading features in the geological structure of the districts embraced. Prof. Hull has, moreover, largely availed himself of the report prepared by the recent Coal Commission, the chief results of which have been embodied in his work. That report, as everyone knows, has calmed the fears of those who saw looming in the near future the exhaustion of our coal supplies and the consequent decline of our industries. It is comfortable to reflect upon the fact that we have still 146,480 millions of tons available within a depth of 4,000 feet, and something like 48,465 millions of tons at a greater depth. From the first of these estimates, Prof. Hull would deduct one-twentieth for coal-seams under two feet in thickness, thus leaving the available quantity of 139,156 millions of tons lying within a depth of 4,000 feet from the surface. Beyond this depth he believes it will not be practicable to penetrate, owing to the effect of increasing temperature and pressure. This, however, is quite an open question. No good reason can be shown why ventilation should not be made effective at a still greater depth than 4,000 feet. If the deeper-lying coal should ever be needed no doubt the engineers of the future will be equal to the occasion and able to render it available. Then, as regards the effect of pressure, we know from actual experience that the "density of coal-seams is not perceptibly greater at 500 or 600 yards than at half that depth." One might almost have inferred as much beforehand, for many of our coal-fields which are now being worked at easy depths must at one time have been covered with thousands of feet of strata, long since removed by denudation; yet the seams in such fields are not denser than those of fields which do not appear to have been covered by such great rock masses. Again, we have heard mining engineers assert that the increased pressure in the deeper pits actually aids in the excavation of the coal, which comes away in larger lumps than would be the case with a similar coal in shallower workings. But whether or not it will ever be necessary to sink deeper than 4,000 feet, there can be no doubt that there is yet abundance of fuel above that limit to keep our furnaces going for many long years to come, and if Britain be destined ere long to retire from her place in the vanguard of nations her loss of prestige will probably be due to other causes than the exhaustion of her mineral resources.

The author expresses himself strongly on the subject of "waste" in working the coal, but not a whit more strongly than is necessary. Everyone who has any acquaintance with British collieries knows how lamentably great this waste is, amounting in some cases to so much as 40 per cent. No doubt, in many of our best conducted collieries waste is reduced to a minimum, but there is still woful need for improvement in this matter. It is, of course, impossible for Government to interfere in squabbles about disputed boundaries, &c., and hence jealousy and stubbornness will continue to put considerable areas of coal beyond the chance of being "won." But surely something might be done towards increasing the number of our mining schools; and, as Prof. Hull suggests, the Legislature might establish some educational test without which no one should be allowed to have the supervision of colliery workings. With well-educated managers the waste of coal arising from ignorant methods of working would be checked, and we should hear less frequently of those frightful accidents which ever and anon throw whole mining communities into mourning. J. G.

The Natural History of Plants. By H. Baillon; translated by M. M. Hartog. Vol II. (London: L. Reeve and Co., 1872.)

PURSUING the somewhat erratic arrangement to which we alluded in our notice of the first volume of this work (see NATURE, vol. iv. p. 199), Prof. Baillon proceeds to an account of the small order of Connaraceæ, the three sections of the large order Leguminosæ, viz., Mimoseæ, Cæsalpinieæ, and Papilionaceæ, and then goes off at a tangent to four orders of Incompletæ, viz., Proteaceæ, Lauraceæ, Elæagnaceæ, and Myristacaceæ. The same plan is pursued as in the first volume, of giving first of all a general sketch of the characters of the order, and then dividing it into a number of "series," each containing one or more genera. An immense mass of information is thus collected, though wanting in convenient arrangement. The references to original authorities are, however, commendably copious. The illustrations, as before, are excellent, the translation apparently well and carefully done.

Memorandum des Travaux de Botaniquè et de Physiologie végétale qui ont été publiés par l'Académie Royale de Belgique pendant le premier siècle de son existence, 1772—1871. Rapport Séculaire per E. Morren. (Bruxelles: Hayez, 1872.)

THOUGH Belgium has not produced any botanical star of the first magnitude, yet a large amount of excellent work has been done in the little kingdom, especially during the period of its independent existence, since 1830, as shown by the labours of Decaisne in the flora of Japan, and of Galeotti in that of Mexico, of Jean Kickx in cryptogamic botany, of Charles Morren in teratology and general morphology, and of Quetelet in the periodic phenomena of vegetation. M. E. Morren's short abstract of the service done by his countrymen in each department of botany, with a list of the dates of publication of the various memoirs, is a useful contribution to the history of the science.

Results of Five Years' Meteorological Observations for Hobart Town.

WE are here presented with carefully constructed tables and valuable remarks on the climate and vital statistics of Tasmania. It includes the results of observations for the five years ending in 1870, with which are incorporated the statistics for the previous twenty-five years, so that it presents us with a complete set of statistics of meteorology for thirty years. That the observations have been carefully and correctly made is proved by the fact that the results of thirty years' observations agree very closely with those of the twenty-five years, the difference in many cases amounting to only a second or third place of decimals. The observations for the five years ending 1870, have been made gratuitously at the Toronto Observatory, by Mr. Francis Abbott, the tables having been constructed by Mr. T. Roblin, Curator of the Museum, and revised by Dr. E. Swarbeck Hall, who appends an elaborate and carefully drawn up health report for Tasmania. The introduction, among other matters, contains a descriptive list of the various instruments used; the set seems to be complete, and all the apparatus trustworthy. The following are the mean resultants from the thirty years' observations for Hobart Town from 1841 to 1870 inclusive:—Barometer (at temperature 32°), 29·580. Thermometer, mean temperature, 54·72; mean diurnal range, 17·91; mean solar intensity, 93·39; mean terrestrial radiation, 43·01. Humidity of air—Dew point—mean position. 45·49; humidity of air, 75; elastic force of vapour, 316; condensation, rain in inches, 1 89; number of days on which rain fell, 11 66; Ozone, mean daily amount, 7 24; prevailing direction of wind, N.W., S.E.; prevailing force of wind, 58 37 lbs. per square foot.

Jahrbuch der k. k. Geologischen Reichsanstalt, xxii. band, No. 2. (Wien.)

FRANZ RITTER V. HAUER gives, in this number of the Year-book, an outline sketch of the sedimentary formations met with in Austria. He arranges his materials somewhat after the manner of Studer's "Index der Petrographie," the names of the various deposits following in alphabetical order. The geological horizons are briefly indicated, and copious references to authorities are given. The descriptions are necessarily brief, but they are clear and comprehensive, and the paper will be invaluable to those who may desire to widen their acquaintance with Austrian geology. Among the mineralogical contributions, we notice the description of a new mineral from Mexico—*Guadalcazerite*, the composition of which is given as $6\ H_g\ S + Z_n\ S$. From the laboratory of Prof. Bauer come several useful rock-analyses, chiefly ironstones. Professor Tschermak gives a description of sundry meteorites, and some account of basalts, metaphyres, and other eruptive rocks from the Caucasus. There is also an interesting paper by Professor Inostranzeff on the Vesuvian lavas of 1871 and 1872.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Prof. Balfour Stewart on the Spectroscope

I BEG to say a few words in reply to some statements in the letter of Prof. Balfour Stewart in NATURE, February 20.

1st. I wish to state that I had no knowledge of Mr. Proctor's letter in the *English Mechanic* until I saw it by accident in a copy of that journal which had been sent to me for another matter. I have never made the claim to which Prof. Stewart refers.

2nd. The note in Schellen's "Spectrum Analysis," of which Prof. Stewart asks an explanation, consists of three statements of fact.

α "Though to Mr. Lockyer is due the first publication of the idea of the possibility of applying the spectroscope to observe the red flames in sunshine, as a matter of history it should not be passed over that about the same time the same idea occurred independently to Mr. Stone, of Greenwich, and to Mr. Huggins." I wish to remark that I made no claim on Mr. Stone's part or on my own. On the contrary I said expressly "*as a matter of history*" these facts should not be passed over. I conceive that this statement of facts ought to have a place in a book which professes to give the history of the subject.

β "These observers were, however, unsuccessful in numerous attempts which they made to see the spectra of the prominences, for the reason probably that the spectroscopes they employed were not of sufficient dispersive power to make the bright lines of the solar flames easily visible." Prof. Stewart remarks that he "cannot yet understand" why I failed. The reasons can now be a matter of conjecture only. All workers in science know how much more difficult it is to discover the unknown than to recognise the known. It may be that I passed over too carelessly the deep red (C) and the blue (F) where the brightest lines occur. The observation of the bright lines in the star in Corona B (May 1866), in which the same sifting principle of the prism came into operation, should have suggested to me to look for the lines of hyrdogen. Later (June 1867) Mr. Johnstone Stoney showed, in an important paper on the "Constitution of the Sun and Stars," that hydrogen was to be expected. I acknowledge that I ought to have found the lines.

γ "When the position of the lines was known, Huggins saw them instantly with the same spectroscope which he had previously used in vain." Of course in this remark I refer only to my own experience; I do not wish to be thought to imply that such assistance was either needed or received in the case of any other observer. Prof. Stewart asks why I did not see the lines sooner after receiving the news from India. This question awakens painful memories. At the time the Indian reports reached me I was watching by the bed of the dying, and a few days afterwards I suffered so severe a bereavement that I was unable to resume work in the observatory until the beginning of December, when I saw the lines. William Huggins

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The Beginnings of Life

It seems advisable for me not to pass without comment the communication made by Dr. Wm. Roberts, of Manchester, in last week's Nature.

Dr. Roberts calls attention to what he considers two possible sources of error in my experiments. The first is the "possibility of the introduction of atmospheric germs at the moment of sealing the vessels," owing, as he says, to the fact "that the sealing can only take place just as ebullition is about to cease," and to the consequent risk of some "reflux of air into the flask." After Dr. Roberts has made a series of experiments similar to those which have been recently cited in these columns (see Nature, Feb. 6, p. 275 with *Erratum* in Feb. 13, p. 296), he may perhaps be a little less apprehensive as to this source of contamination. It is, however, not the fact that flasks cannot be sealed during ebullition, and this I shall be very happy to demonstrate to Dr. Roberts. Moreover, if he will refer to Dr. Sanderson's letter, Dr. Roberts will find that in speaking of the sealing of the flasks in the blow-pipe flame, he says care was taken "to continue the ebullition to the last." And in several series of experiments M. Pasteur also made use of flasks which had been sealed during ebullition—believing that in so doing he was experimenting with vessels from which all living germs had been excluded. Speaking of the preparation of such flasks, Pasteur says (*Ann. de Chim. et de Physique*, 1862, p. 74): "je ferme l'extremité effilée pendant l'ebullition. Le vide se trouve fait dans les ballons" No one has hitherto questioned M. Pasteur's skill as an experimenter.

The second alleged source of error is, according to Dr. Roberts, much more important. My mode of experimentation, he says, "does not insure that the entire contents of the flask are effectively exposed to the boiling heat." Although Dr. Roberts confirms my statement that many fluids treated in the manner I have described do soon swarm with living things, he seems to think their appearance may be due to the fact that several of the mixtures "froth excessively in boiling, and spurt about particles which adhere to the glass, and probably some of these escape the full effect of the heat." I feel quite sure that in my experiments no portion of the inner surface of the glass has escaped the scathing action of the boiling fluid The vessel has generally been more than three-fourths full before the process of heating has been commenced, so that when ebullition occurs the fluid has always swept over the previously uncovered inner surface and, as Dr. Sanderson testifies, "during the boiling some of the liquid was frequently ejected from the almost capillary orifice of the retort." The inner surface of the vessel was, in fact, always thoroughly and repeatedly washed with the boiling fluid, nearly half of which has been spurted away in order that I might effect this object

Dr. Roberts says:—"Dr. Sanderson is, however, careful not to endorse the conclusions which Dr. Bastian has drawn from these experiments." But this is scarcely a fair statement, since Dr. Sanderson had near the beginning of his letter announced his intention of taking no part in the controversy. Dr. Sanderson's opinions, however, on the elements of the question have already been set forth (see Thirteenth Report of Medical Officer of Privy Council, p. 59). Whilst not believing in the danger of atmospheric contamination by Bacteria germs, he does believe, in common with other biologists, that immersion in boiling liquids is a ready means of destroying them. If Dr. Sanderson had not thought that the conditions of the experiments were such as to be exclusive of the intervention of living germs, why should he have previously doubted "my statements of fact" in respect to them? Does Dr. Roberts consider Dr. Sanderson so much of a tyro in these matters as to suppose that he would doubt the well-known fact that living germs will always rapidly multiply in suitable fluids? If not, then the only other source of doubt that could have arisen, must have been as to the possibility of the appearance of swarms of living things in hermetically sealed vessels in which all pre-existing organisms had been killed. And if Dr. Roberts wishes ample proof that such has been the view also entertained by others I need only refer him to the last few pages of a curious article (purporting to be a review of my work "The Beginnings of Life"), which appeared in a recent number of a journal (*Quart. Journ. of Micros. Science*) of which Mr. Ray Lankester is one of the editors. It is perhaps fortunate for the reviewer's reputation and for his fame as a scientific experimenter that his name does not appear, or that his unsuccessful experiments, destined to upset my views, were not published before the advent of Dr. Sanderson's letter.

In some respects the actual results of the experiments performed by Dr. Roberts differ from those of other experimenters. Thus he has found that filtered infusions of any animal or vegetable substances can be "invariably preserved unchanged when boiled for five or ten minutes in a flask plugged with cotton wool." The results obtained by M. Victor Meunier and by myself have been different, and we have both shown that they are apt to vary according to the strength and nature of the infusions employed. Dr. Roberts says he has also found that many "highly putrescent mixtures" remained perfectly barren "after the flask containing them had been immersed in a water-bath kept at a boiling heat for twenty or thirty minutes," although several of the same mixtures "could not be kept unchanged by simple boiling over the flame," and the sealing of the flask during ebullition. If, after what I have already said concerning the latter mode of experimentation, anything is to be deduced from these facts, it would perhaps be that the partial vacuum within the flask is more favourable to the initiation of putrefactive changes in some boiled fluids than their contact with filtered air. This is what I have always thought, and evidence pointing that way may be found in *Appendix* C of my "Beginnings of Life." Certainly one cannot assent to the conclusion which Dr. Roberts would draw from such experiments, based upon the supposition that the boiling of the sealed flasks in water is a protective measure. Dr. Roberts' results are here again somewhat different from others which have long become matters of history. Need I say that this was essentially the method of experimentation introduced more than a century ago by Needham, and that his results were confirmed by his adversary, Spallanzani, who says: "L'ebullition d'une demi-heure ne fut pas un obstacle à la naissance des animalcules du dernier ordre qui peuplerent toujours, plus ou moins, tous les vases exposés à son action pendant tout ce temps-là." Does Dr. Roberts forget that Dr. Wyman boiled his flasks for two hours and yet obtained positive results? that he boiled others in a Papin's digester under a pressure of two and five atmospheres respectively, and still obtained living organisms from his flasks. Must I also remind him of the numerous experiments by Prof. Cantoni, of Pavia, in which the hermetically sealed flasks were heated in a Papin's digester to temperatures ranging from 100°—117° C.; and to several of the experiments that I have myself recorded in which undoubtedly—living organisms were obtained from flasks that had been heated in fluids raised to temperatures varying from 130°—153° C. (*e.g.* such experiments as are recorded in "The Beginnings of Life," vol. i. pp. 441, 443, 447, and 463).

When will those who do me the honour of referring to my experiments look all round and cease to argue from one half of the facts? H. Charlton Bastian

University College, Feb. 24

Himalayan Ferns

During the years 1861–66 I took every available opportunity to collect ferns in the Sevalik and Himalaya ranges. There being at that period no published work on the ferns of British India, and one subsequently published in Madras not having come under my notice, my specimens, several hundred in number, and all well dried, remain unclassified.

Would this collection be of any scientific value, and if so, to what society could I present it? I opine it would be worse than useless to offer it to the herbarium of the British Museum, as there it might remain untouched for the next fifty years; whilst at Kew I presume Hooker's superior collection would render my poor mite useless.

If not worthy of presentation to any herbarium, would any competent botanist classify it for the sake of the duplicates?

F. G. S. P.

General Travelling Notes

During the years 1857–66 I was in India, and in that period travelled much, both in the Plains and the interior of the Himalaya.

Since my return to England I have constantly regretted that I took few notes, and those few notes, from lack of knowledge, of little or no value, on flora, fauna, geology, and altitudes. In a few months I shall return to the same part of India (North West Provinces and Punjâb), and purpose remaining in that country for some years. There are many men in the army who, like myself, have a general taste for scientific observations, but our efforts end in gratifying our own minds only, our observations lacking sufficient accuracy and classification, whilst much is overlooked from sheer ignorance as to the how and where to look.

To the end that I (and others of like mind) may, perchance, furnish some useful jottings during my next term of foreign service, can any contributor to Nature inform me where the following are to be met with:—

1. A plain code of what to look for and observe, after the manner of, but shorter than, "The Scientific Orders of the *Challenger*," published in Nature for Jan. 9 and 30.

2. What is the best text-book on each head (*e.g.* on barometrical and thermometrical observations, Indian geology, botany, &c.). It is very essential each such text-book should be comprised in one handy volume; if possible as clear and concise as Tyndall's "Lectures on Electricity."

3. What instruments should be taken. I suggest—An ordinary thermometer, tested at Kew; a max. and a min. thermometer; an aneroid (of what size?); a prismatic compass; an Abney's clinometer-level for ascertaining the slope and consequent height of mountains and depths of valleys roughly; also a small *portable* rain-gauge, if such is made; a simple microscope, and a magnifying glass. Are these sufficient? and if so, where should they be procured, and at what price? the *cost* being a vital point.

4. Can these, or similar instruments, be obtained in a single case sufficiently small to be carried, like a small theodolite box, in one hand?

F. G. S. P.

Mirage

The following references to the literature of this subject are in answer to the note by Prof. J. D. Everett in Nature for January 2 last:—

Bravais, Aug.—"Notice sur le mirage," Annuaire Soc. Meteor. Fr., p. 227 (1852), p. 55 (1855).

Dufour, Charles.—"Mirages et réfractions aunormales sur le lac Leman," Bull. Soc. Vaud. Lausanne, vol. iv. p. 366 (1854-5); 386; vol. v. p. 26 (1856); 217.

Escayrac de Lauture.—"Sur le ragle ou hallucination du désert," Bull. Soc. Geogr, vol. ix. p. 121 (1855).

Gergonne, J. D.—"Recherches sur les refractions terrestres et particulièrement sur le mirage," Notice Trao. Acad. Gard., p. 129 (1808).

Gergonne, J. D.—"Essai analytique sur la phenomène du mirage," Ann. Math. Gergonne, xx. p. 1 (1829).

Giovene, G. M.—"Wunderbare Phänomene nach Art der Fata Morgana," Gilbert, Annal. xii. p. 1 (1803).

Jackson, C. T.—"Observations on the Mirage seen on Lake Superior in July and August 1847," Proc. Amer. Assoc., p. 143 (1849).

Kelly, W.—"On some extraordinary forms of Mirage," Trans. Lit. Soc. Quebec, vol. iii. p. 292 (1837).

Orioli, F.—"Della Fata Morgana," Tortolini Annali, ii. p. 47 (1851).

Parés.—"Note sur le Mirage," Comptes Rendus, vol. xii. p. 87 (1855).

Parés.—"Note sur le Mirage des Côtes du departement de l'Herault," Mem. Acad. Sci. Montpellier, iii. p. 1; 493 (1855).

A. Ramsay

Brilliant Meteor of Feb. 3

To supplement Prof. Osborne Reynolds' interesting paper on the meteor of February 3, which he saw in Manchester, and which he thinks must have passed over Chester and Liverpool (Nature, February 20, p. 315), I enclose you a cutting from a local Cheshire paper showing that this meteor was seen about the same time in Northwich, which is some twenty-five or thirty miles S.W. from Manchester, and almost in a direct line drawn from Manchester to Chester.

By consulting the various local papers published in Northwich, Chester, Birkenhead, Liverpool, &c., it could easily be discovered at what place it was last seen, and where the loudest explosion was heard, and so the approximate path of this splendid meteor and its height might be traced out. These papers will mostly all be found in the Exchange and the Athenæum Reading Rooms, Manchester, where I believe they are regularly filed.

Merton College, Oxford J. P. Earwaker

"A Meteor Shower at Northwich.—At Northwich on Monday night, February 3, about ten o'clock, a very brilliant meteor was observed in the sky passing from east to west. The meteor displayed an intense white light in its course, and emitted sparks which appeared of various hues. It was visible about six or eight seconds, and from one to two minutes after the passage of the meteor a loud rumbling report like distant thunder was heard. The night was very clear, and starlight at the time."

A very bright meteor was imperfectly seen here by me at $9^h\ 58^m$ on Monday evening, February 3. At the time of its appearance the sky was much clouded though not entirely overcast, and became suddenly illuminated by what I at first considered to be flashes of lightning. The clouds in the north sky particularly were illuminated, and as I thought it possible that the phenomenon might be due to the appearance of a large fireball behind the clouds, I noted the exact situation in which the greatest quantity of light (which was about equal to the moon when five days past conjunction) existed. This was, as accurately as could possibly be determined, at a place about 10° eastward of the north point, or north by east, and in the vicinity of the horizon. When traversing this part of its path it is possible that the meteor was at its brightest, and on the point of disappearance. It was impossible to note any further details as to the exact course of the luminous appearance seen, inasmuch as but few stars were perceptible, and the north sky was much obscured by cumulus clouds. This meteor was also seen at Manchester at $9^h\ 57^m$; it appeared near the zenith of that station.

Bristol William F. Denning

Inherited Feeling

As every instance of inherited antipathy in the offspring of Turk adds to the weight of proof, I beg to state that a mastiff in my possession, a grandson of Turk, and a brother of Mr. Brooke's dog, showed the same unaccountable antipathy to butchers, manifesting violent rage when any one of that honourable fraternity showed himself in the yard where he was kept. He was otherwise of a remarkably mild and gentle disposition.

Bowdon, near Manchester, Arthur Ransom
Feb. 21

Would it not test the correctness of Mr. Wallace's ingenious theory as to animals finding their way back over an unseen country by their sense of smell, to shut up a cat in a basket along with a piece of stale fish, the scent of which would certainly overpower any external scent by which it might be able to trace the way back? It seems to me that many instances are on record of this curious power of certain animals, especially of cats, which are quite inexplicable on Mr. Wallace's hypothesis.

Alfred W. Bennett

External Perception in Dogs

The view to which Mr. Wallace gives expression in your last number had occurred also to me, and I should like, with your leave, to offer a remark or two in support of it.

That a dog shut up in a basket may through smell acquire a series of impressions so definitely marked as to be able therewith to find its way back to the place it was taken from, becomes less improbable if we think what is the part that must be played by smell in its ordinary objective experience. Our external world (whether as actually perceived or imaginatively represented) may be called a world of sights and touches, blended with and modifying each other in the most intimate way. These mutually involved sights and touches, in our consciousness, are run out into the form of a *continuum* in space (how or why it is not to the present purpose to inquire), while all other sensations, as of hearing, smell, and taste, come before us only discontinuously and intermittently, not being had from all things nor always from the same things. But in a dog's experience touch cannot possibly co-operate with sight as it regularly does in ours. The organ of effective touch in man—touch that gets associated with vision—is in the last resort the hand, combining mobility and sensitiveness in the highest degree; and the dog has no hand. Its mobile limbs are not sensitive at the extremities, and, though it has sensitive lips, these, having no such active mobility as the human hand has, are extremely limited in the scope of their apprehension. Its touch being thus defective, what is there then in the dog to play second to sight, which as leader needs support, were it only because there is not always light to see with? Smell, I cannot but think, seeing that, while the organ is incontestably acute, it has the great advantage over the tactile surface of the lips, of receiving impressions from things already at a distance. If we only suppose—what the facts make very likely—that the dog's smell is acute enough to have some sensation from all bodies without exception, nothing more is wanting to enable a psychologist to understand that the dog's world may be in the main a world of sights and smells continuous in space. In that case a dog conveyed in a basket might by smell alone find its way back pretty much as a man blindfolded finds his way by touch alone.

To argue properly so difficult a question is impossible in a short letter, and I must be content now, for reasons like those indicated rather than stated above, with giving my adhesion to Mr. Wallace's view—so far at least as dogs are concerned, and to the extent that in smell we have a source of explanation for the phenomena which has never been sufficiently considered. That the explanation covers all the facts related even about dogs is more than I would assert; and whether it is equally serviceable for other animals like cats and horses, concerning which not less wonderful stories are told, is not so clear. Cats, however, seem to have very acute smell. What is the truth about the smell of horses?

G. CROOM ROBERTSON

University College, Feb. 24

Fiords and Glacial Action

IN NATURE, vol. vii. pp. 94, 95, I find the following:—

"*Poggendorf's Annalen*—A. Helland adduces a large amount of evidence to show that the fiords in Norway have been formed by glacial action."

It appears an obvious remark, and yet I have not met with it, that fiords are chiefly found in those coasts where from the geographical conditions there must have been the most glacial action. The most favourable conditions for glacial action are evidently those of a mountainous coast in a high and therefore cold latitude, fronting the rain and snow-laden west winds of the higher latitudes as they blow in from the ocean. These conditions are fulfilled in the highest degree by the coasts of Norway and Western Scotland: the western coast of North America from Vancouver's Island northwards; and the western coast of South America from Chiloe southwards; and these coasts are accordingly more cut up into fiords than any others in the world.

The western coast of America along the enormously long line from Vancouver's Island to Chiloe is one of the most unbroken in the world. It is significant that the change in the coast at Chiloe from an unbroken one to one very much broken into fiords is accompanied by a great and comparatively abrupt change in the height of perpetual snow on the Andes. The following are the heights of perpetual snow at three different latitudes, according to Mrs. Somerville's "Physical Geography." The first two are north of Chiloe, the third south of it.

About 33° S. (near Valparaiso) . . .	12,780 feet
„ 37° 40′ S.	7,960 „
„ 53° (Strait of Magellan)	3,390 „

Although the height of the snow-line depends chiefly on latitude, it is sensibly influenced by the aspect of the mountains respecting the rain and snow-bearing winds. The best instance of this is probably that of the Himalayas, where, according to Mrs. Somerville (page 314), the height of the snow-line is 16,620 feet on the north side, and only 12,980 on the south. According to another authority (Capt. Strachey), quoted by Mrs. Somerville (p. 54), the heights are 19,000 to 20,000 feet on the north side, and 15,500 on the southern. The difference of the two estimates is about the same. The reason of the difference is evidently that the south side receives the moisture-laden winds from the Indian Ocean.

Old Forge, Dunmurry JOSEPH JOHN MURPHY

NOTE ON A POLYDACTYLOUS CAT FROM COOKHAM-DEAN

BY the kindness of Dr. Plumbe, of Maidenhead, I have been able to procure one of these cats; and from the many curious points he possesses, I think a note on his peculiarities will interest some of the readers of NATURE.

Readers of Mr. Darwin's "Origin of Species" are familiar enough with the illustration he gives of correlation of arrest of development in the deafness of blue-eyed cats. Some years ago I showed that our great naturalist had fallen into error on this point, and that the correlation is not between the blue eyes and the deafness, but between the latter and the sex of the cat.

I have made a great many inquiries on this point, and have completely confirmed my former observation, that all perfectly white tom-cats are deaf, and that they have blue eyes occasionally, because that item of beauty is common among white cats. I have seen many white Tabithas with blue eyes, but none of them were deaf. My little "Pudge" from Cookham is perfectly deaf, and has one blue eye and a yellow one. For the first few days after I had him, I thought he could hear a little, but am now quite satisfied that his deafness is complete, though he is alive to sounds conveyed through solid media. A further point of interest is that he is not mute as most deafs are, but there is a kittenish shrillness in his voice and a loudness in his purring, which are not commensurate with his age. I think, therefore, that it is possible that early in life he may have heard a little, for I know of two instances where perfect mutism accompanied the deafness in cats, and I do not know of any contrary condition. The one yellow eye favours my view that "Pudge" may have heard in infancy his mother's voice. His sense of touch is extremely acute compared to that of another cat I have, but his sight does not seem so sharp as that of cats generally is. He has twenty-six digits, and these are arranged—seven on each fore limb, and six on each hind limb. The supernumerary digits on the fore limbs are thumbs, and are placed one on either side of the true pollex, being joined to it, but having no metacarpal bones. In the hind limb the supernumerary digit is probably of the same nature, or a supernumerary index, being placed on the outer side of the hallux, and attached to the tarsus by a completely-developed metatarsal bone.

LAWSON TAIT

ON ACTION AT A DISTANCE*

I HAVE no new discovery to bring before you this evening. I must ask you to go over very old ground, and to turn your attention to a question which has been raised again and again ever since men began to think.

The question is that of the transmission of force. We see that bodies at a distance from each other exert a mutual influence on each other's motion. Does this mutual action depend on the existence of some third thing, some medium of communication, occupying the space between the bodies, or do the bodies act on each other immediately without the intervention of anything else?

The mode in which Faraday was accustomed to look at phenomena of this kind differs from that adopted by many other modern inquirers, and my special aim will be to enable you to place yourselves at Faraday's point of view, and to point out the scientific value of that conception of *lines of force* which, in his hands, became the key to the science of electricity.

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* Lecture delivered at the Royal Institution, Feb. 21, 1873, by Prof. Clerk Maxwell.

When we observe one body acting on another at a distance, before we assume that this action is direct and immediate, we generally inquire whether there is any material connection between the two bodies, and if we find strings, or rods, or mechanism of any kind, capable of accounting for the observed action between the bodies, we prefer to explain the action by means of these intermediate connections, rather than to admit the notion of direct action at a distance.

Thus when we ring a bell by means of a wire, the successive parts of the wire are first tightened and then moved, till at last the bell is rung at a distance by a process in which all the intermediate particles of the wire have taken part one after the other. We may ring a bell at a distance in other ways, as by forcing air into a long tube at the other end of which is a cylinder with a piston which is made to fly out and strike the bell. We may also use a wire, but instead of pulling it, we may connect it at one end with a voltaic battery, and at the other with an electro-magnet, and thus ring the bell by electricity.

Here are three different ways of ringing a bell. They all agree, however, in the circumstance that between the ringer and the bell there is an unbroken line of communication, and that at every point of this line some physical process goes on by which the action is transmitted from one end to the other. The process of transmission is not instantaneous, but gradual, so that there is an interval of time after the impulse has been given to one extremity of the line of communication, during which the impulse is on its way, but has not reached the other end.

It is clear, therefore, that in many cases the action between bodies at a distance may be accounted for by a series of actions between each successive pair of a series of bodies which occupy the intermediate space, and it is asked, by the advocates of mediate action, whether, in those cases in which we cannot perceive the intermediate agency, it is not more philosophical to admit the existence of a medium which we cannot at present perceive, than to assert that a body can act at a place where it is not.

To a person ignorant of the properties of air, the transmission of force by means of that invisible medium would appear as unaccountable as any other example of action at a distance, and yet in this case we can explain the whole process, and determine the rate at which the action is passed on from one portion to another of the medium.

Why then should we not admit that the familiar mode of communicating motion by pushing and pulling with our hands is the type and exemplification of all action between bodies, even in cases in which we can observe nothing between the bodies which appears to take part in the action?

Here for instance is a kind of attraction with which Prof. Guthrie has made us familiar. A disc is set in vibration, and is then brought near a light suspended body, which immediately begins to move towards the disc as if drawn towards it by an invisible cord. What is this cord? Sir W. Thomson has pointed out that in a moving fluid the pressure is least where the velocity is greatest. The velocity of the vibratory motion of the air is greatest nearest the disc. Hence the pressure of the air on the suspended body is less on the side nearest the disc than on the opposite side, the body yields to the greater pressure, and moves toward the disc.

The disc, therefore, does not act where it is not. It sets the air next it in motion by pushing it, this motion is communicated to more and more distant portions of the air in turn, and thus the pressures on opposite sides of the suspended body are rendered unequal, and it moves towards the disc in consequence of the excess of pressure. The force is therefore a force of the old school—a case of *vis à tergo*, a shove from behind.

The advocates of the doctrine of action at a distance, however, have not been put to silence by such arguments. What right, say they, have we to assert that a body cannot act where it is not? Do we not see an instance of action at a distance in the case of a magnet, which acts on another magnet not only at a distance, but with the most complete indifference to the nature of the matter which occupies the intervening space? If the action depends on something occupying the space between the two magnets, it cannot surely be a matter of indifference whether this space is filled with air or not, or whether wood, glass, or copper, be placed between the magnets.

Besides this, Newton's law of gravitation, which every astronomical observation only tends to establish more firmly, asserts not only that the heavenly bodies act on one another across immense intervals of space, but that two portions of matter, the one buried a thousand miles deep in the interior of the earth, and the other a hundred thousand miles deep in the body of the sun, act on one another with exactly the same force as if the strata beneath which each is buried had been non-existent. If any medium takes part in transmitting this action, it must surely make some difference whether the space between the bodies contains nothing but this medium, or whether it is occupied by the dense matter of the earth or of the sun.

But the advocates of direct action at a distance are not content with instances of this kind, in which the phenomena, even at first sight, appear to favour their doctrine. They push their operations into the enemy's camp, and maintain that even when the action is apparently the pressure of contiguous portions of matter, the contiguity is only apparent—that a space *always* intervenes between the bodies which act on each other. They assert, in short, that so far from action at a distance being impossible, it is the only kind of action which ever occurs, and that the favourite old *vis à tergo* of the schools has no existence in nature, and exists only in the imagination of schoolmen.

The best way to prove that when one body pushes another it does not touch it, is to measure the distance between them. Here are two glass lenses, one of which is pressed against the other by means of a weight. By means of the electric light we may obtain on the screen an image of the place where the one lens presses against the other. A series of coloured rings is formed on the screen. These rings were first observed and first explained by Newton. The particular colour of any ring depends on the distance between the surfaces of the pieces of glass. Newton formed a table of the colours corresponding to different distances, so that by comparing the colour of any ring with Newton's table, we may ascertain the distances between the surfaces at that ring. The colours are arranged in rings because the surfaces are spherical, and therefore the interval between the surfaces depends on the distance from the line joining the centres of the spheres. The central spot of the rings indicates the place where the lenses are nearest together, and each successive ring corresponds to an increase of about the 4,000th part of a millimetre in the distance of the surfaces.

The lenses are now pressed together with a force equal to the weight of an ounce, but there is still a measurable interval between them, even at the place where they are nearest together. They are not in optical contact. To prove this, I apply a greater weight. A new colour appears at the central spot, and the diameters of all the rings increase. This shows that the surfaces are now nearer than at first, but they are not yet in optical contact, for if they were, the central spot would be black. I therefore increase the weights, so as to press the lenses into optical contact.

But what we call optical contact is not real contact.

Optical contact indicates only that the distance between the surfaces is much less than a wave-length of light. To show that the surfaces are not in real contact, I remove the weights. The rings contract, and several of them vanish at the centre. Now it is possible to bring two pieces of glass so close together, that they will not tend to separate at all, but adhere together so firmly that when torn asunder the glass will break, not at the surface of contact, but at some other place. The glasses must now be many degrees nearer than when in mere optical contact.

Thus we have shown that bodies begin to press against each other while still at a measurable distance, and that even when pressed together with great force they are not in absolute contact, but may be brought nearer still, and that by many degrees.

Why, then, say the advocates of direct action, should we continue to maintain a doctrine founded only on the rough experience of a pre-scientific age, that matter cannot act where it is not, instead of admitting that all the facts from which our ancestors concluded that contact is essential to action were in reality cases of action at a distance, the distance being too small to be measured by their imperfect means of observation?

If we are ever to discover the laws of nature, we must do so by obtaining the most accurate acquaintance with the facts of nature, and not by dressing up in philosophical language the loose opinions of men who had no knowledge of the facts which throw most light on these laws.

And as for those who introduce ætherial, or other media, to account for these actions, without any direct evidence of the existence of such media, or any clear understanding of how the media do their work, and who fill all space three and four times over with æthers of different sorts, why the less these men talk about their philosophical scruples about admitting action at a distance the better.

If the progress of science were regulated by Newton's first law of motion, it would be easy to cultivate opinions in advance of the age. We should only have to compare the science of to-day with that of fifty years ago, and by producing, in the geometrical sense, the line of progress, we should obtain the science of fifty years hence.

The progress of science in Newton's time consisted in getting rid of the celestial machinery with which generations of astronomers had encumbered the heavens, and thus "sweeping cobwebs off the sky."

Though the planets had already got rid of their crystal spheres, they were still swimming in the vortices of Descartes. Magnets were surrounded by effluvia, and electrified bodies by atmospheres, the properties of which resembled in no respect those of ordinary effluvia and atmospheres.

When Newton demonstrated that the force which acts on each of the heavenly bodies depends on its relative position with respect to the other bodies, the new theory met with violent opposition from the advanced philosophers of the day, who described the doctrine of gravitation as a return to the exploded method of explaining everything by occult causes, attractive virtues, and the like.

Newton himself, with that wise moderation which is characteristic of all his speculations, answered that he made no pretence of explaining the mechanism by which the heavenly bodies act on each other. To determine the mode in which their mutual action depends on their relative position was a great step in science, and this step Newton asserted that he had made. To explain the process by which this action is effected was a quite distinct step, and this step, Newton, in his "Principia," does not attempt to make.

But so far was Newton from asserting that bodies really do act on one another at a distance, independently of anything between them, that in a letter to Bentley which has been quoted by Faraday in this place, he says:—

"It is inconceivable that inanimate brute matter should, without the mediation of something else, which is not material, operate upon and affect other matter without mutual contact, as it must do if gravitation, in the sense of Epicurus, be essential and inherent in it. . . . That gravity should be innate, inherent, and essential to matter, so that one body can act upon another at a distance, through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it."

Accordingly, we find in his "Optical Queries," and in his letters to Boyle, that Newton had very early made the attempt to account for gravitation by means of the pressure of a medium, and that the reason he did not publish these investigations "proceeded from hence only, that he found he was not able, from experiment and observation, to give a satisfactory account of this medium, and the manner of its operation in producing the chief phenomena of nature." *

The doctrine of direct action at a distance cannot claim for its author the discoverer of universal gravitation. It was first asserted by Roger Cotes, in his preface to the "Principia," which he edited during Newton's life. According to Cotes, it is by experience that we learn that all bodies gravitate. We do not learn in any other way that they are extended, moveable, or solid. Gravitation, therefore, has as much right to be considered an essential property of matter as extension, mobility, or impenetrability.

And when the Newtonian philosophy gained ground in Europe, it was the opinion of Cotes rather than that of Newton that became most prevalent, till at last Boscovich propounded his theory, that matter is a congeries of mathematical points, each endowed with the power of attracting or repelling the others according to fixed laws. In his world, matter is unextended, and contact is impossible. He did not forget, however, to endow his mathematical points with inertia. In this some of the modern representatives of his school have thought that he "had not quite got so far as the strict modern view of 'matter' as being but an expression for modes or manifestations of 'force.'" †

But if we leave out of account for the present the development of the ideas of science, and confine our attention to the extension of its boundaries, we shall see that it was most essential that Newton's method should be extended to every branch of science to which it was applicable—that the forces with which bodies act on each other should be investigated in the first place, before attempting to explain *how* that force is transmitted. No men could be better fitted to apply themselves exclusively to the first part of the problem, than those who considered the second part quite unnecessary.

Accordingly Cavendish, Coulomb, and Poisson, the founders of the exact sciences of electricity and magnetism, paid no regard to those old notions of "magnetic effluvia" and "electric atmospheres," which had been put forth in the previous century, but turned their undivided attention to the determination of the law of force, according to which electrified and magnetised bodies attract or repel each other. In this way the true laws of these actions were discovered, and this was done by men who never doubted that the action took place at a distance, without the intervention of any medium, and who would have regarded the discovery of such a medium as complicating rather than as explaining the undoubted phenomena of attraction.

(*To be continued.*)

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* Maclaurin's Account of Newton's Discoveries.

† Review of Mrs. Somerville's "Molecular Science," *Saturday Review*, Feb. 13, 1869.

THE TROGLODYTES OF THE VEZERE*

II.

WE have now examined the succession of prehistoric periods, from the beginning of the quaternary epoch, under the threefold aspect of stratification, palæontology, and archæology. We have thus obtained three series of dates, which do not always agree very strictly. They coincide only in the latest date, which marks the commencement of the modern epoch, and only approximate in the more ancient dates; but that is sufficient to enable us to arrange the following table, as a summary :—

	Stratigraphical Dates.	Palæontological Dates.	Archæological Dates.
Quaternary Epoch	Low level of the valleys undisturbed	Mammoth Age	Hatchet of St. Acheul
	Middle level	Intermediate Age	Moustier point
	Upper level	Reindeer Age	Solutré point
Modern Epoch	Recent soil	Present Fauna	Polished hatchet

II.—*Successive Stations of the Troglodytes of the Vézère*

We now possess the facts necessary to enable us to assign a place in chronology to the Troglodytes of the valley of the Vézère. There is not one polished hatchet to be found in their numerous stations; all their industry belongs to the epoch of hewn stone. They were therefore anterior to the modern epoch. They were acquainted with the mammoth; they fought him; they ate him; they even sketched him; they also knew the gigantic cave lion, and the cave hyena. Nevertheless, in their most ancient station—at least, the oldest with which we are acquainted, that of Moustier—the extinct species are already very rare. Our Troglodytes, therefore, do not date from the first quaternary period or Mammoth Age; but their station at Moustier belongs incontestably to the age which we have called intermediate, and which preceded the Reindeer Age.

Their other stations range from epoch to epoch until the end of the Reindeer Age; they therefore helped to destroy the ancient fauna. They did not, it is true, witness the disappearance of the last survivor, the mammoth, for some few rare vestiges of that animal are met with in the most recent caves of the Vézère, but at some leagues distance, at Excideuil, where MM. Jules and Phillippe Parrott have discovered a palæolithic cave in which was no trace of the extinct species, and in which even the reindeer was becoming rare.

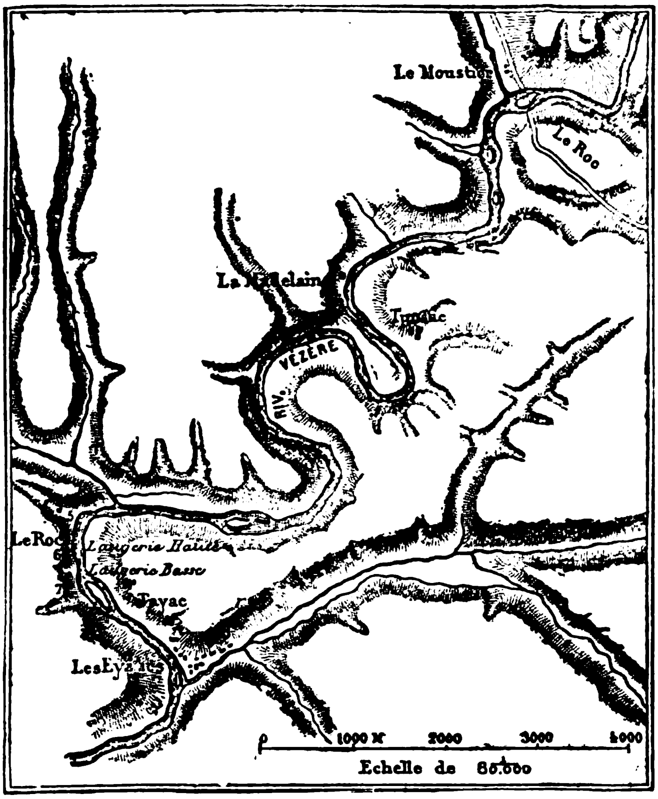

FIG. 8.—Map of the quaternary stations of the Vezère.
1.—Moustier cave. 2.—Moustier shelter. 3—Shelter of the Madelaine. 4.—Shelter and burying-place of Cromagnon. 5.—Shelter of Upper Laugerie. 6.—Shelter of Lower Laugerie. 7.—Cave of the Gorge d'Enfer. 8.—Cave of the Eyzies.

Thus the Troglodytes of Perigord have existed in the two last periods of the quaternary epoch, from the decadence of the mammoth to the disappearance of the reindeer. It is impossible for us to measure the immense number of ages in which they lived, but we can have some idea of it by studying their stations in connection with the level of the Vézère.

Since the Moustier Cave has ceased to be inhabited it has so often been flooded by the Vézère that it has been entirely filled with alluvial earth. This layer of earth, nearly two metres in thickness, does not contain either bones or flint. It has covered the layer which was formerly the inhabited soil, in which man has left the tokens of his industry and the remnants of his feasts. This proves that the mouth of the cave was within reach of frequent floodings, and that consequently it was at a level hardly above that of the river. Now, at the present day, it is situated twenty-seven metres above the lowest watermark; the depth of the valley is therefore considerably increased since the epoch of the Moustier Troglodytes. On the other side, the station of La Madelaine, which is one of the most recent, perhaps *the* most recent of the valley, is very slightly above the level of the largest present floodings. We may hence conclude that the valley of the Vézère was very much then what it is now, and that since the epoch of La Madelaine the level has become lowered to the extent of a few metres only.

Thus this depression of twenty-seven metres, due to the action of the waters, was effected almost entirely under the eyes of our Troglodytes, and from that time, during the whole length of the modern epoch, that is in hundreds of centuries, it has made very little progress. Judge from this how many human generations must have come and gone between the epochs of Moustier and La Madelaine.

It is easy to see that in such an immense lapse of time the manners and industry of this people must have undergone notable changes. We shall have no trouble in proving this by the study of their different stations in succession.

All those of the stations that are known up to the present time are grouped on both banks of the Vézère in a very circumscribed space. From Moustier, which is up the river, to Eyzies, which is down, the distance is but eight kilometres as the crow flies; it is nearly double when you follow the windings of the valley. Between these extreme stations we see succeeding each other, on the right bank, those of the Madelaine, Upper Laugerie,

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* Continued from p 277

Lower Laugerie, the Gorge d'Enfer, then, on the left bank that of Cromagnon, very near the Eyzies (see the map).

Some are really habitable caves, others are simply shelters under the rocks, with large openings towards the valleys. But these distinctions have no chronological importance. It is not by the nature of the habitations, but by the nature of the *debris* they contain that we can estimate their relative antiquity. The stations at Moustier are evidently the oldest, that of Cromagnon is less ancient, but evidently belongs, like the preceding, to the intermediate age. Upper Laugerie, the Gorge d'Enfer, belong to the Reindeer Age; and finally Lower Laugerie, the Eyzies, the Madelaine, form a last group, and bring us to the end of the quaternary epoch.

The Moustier Troglodytes were quite uncivilised. They did not know how to fashion bones and horns; they only understood working in stone. Carved flints abound in their stations, but, with the exception of an arrow-point, rather carefully cut, all these flints are of very rough workmanship. The distinguishing weapon of the Moustier Troglodytes, that which characterises this station and epoch, is the lance or spear-point which we have already described (see above, Figs. 3. 4. and 5).

This powerful flint, with an arched point, sharp at both edges, wide enough to make large wounds, thin enough to penetrate easily into the flesh, constituted a much more terrible weapon than the hatchet of Saint Acheul. Fastened to the end of a spear, it could put to death the most gigantic mammalia. Vestiges of the mammoth, of the huge cave lion, and of the cave hyena have been picked up at Moustier. But the principal human food at that time was first the horse, then the aurochs; the reindeer came third. The weapons of the chase were more suited to attack the enemy that resisted than the game that fled. They neglected those lighter shafts that bring down birds and smaller quadrupeds. Fishing was also neglected and probably not known. There is not a single fish-bone or bird-bone in the Moustier stations.

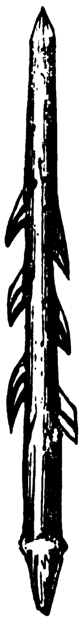

Fig. 9.

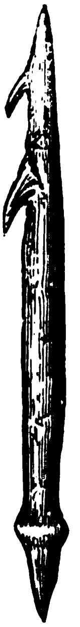

Fig. 10.

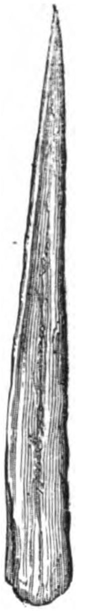

Fig. 11.

Fig. 11.—Point in deer horn, without barbs (Gorge d'Enfer). Fig. 9.—Arrow with bilateral barbs. Fig. 10.—Harpoon with unilateral barbs.

The men of Cromagnon, less ancient than those of Moustier, had considerably advanced. Their implements were less massive, more numerous, more varied, and, above all, better finished. They had not the Moustier point, but they had a kind of flint poignard. They wore shell ornaments, and their numerous scrapers seem to indicate that they prepared skins for clothing. Their principal food was still the horse, but they had a great variety. We find in the *débris* of their repasts, besides the reindeer, which was beginning to be plentiful, bones and teeth of aurochs, wild boar, stag, wild goat, wolf, fox, spermopile, hare, and even of a bird belonging to the Crane genera. They consequently hunted small game as well as large animals; but they were still ignorant of fishing.

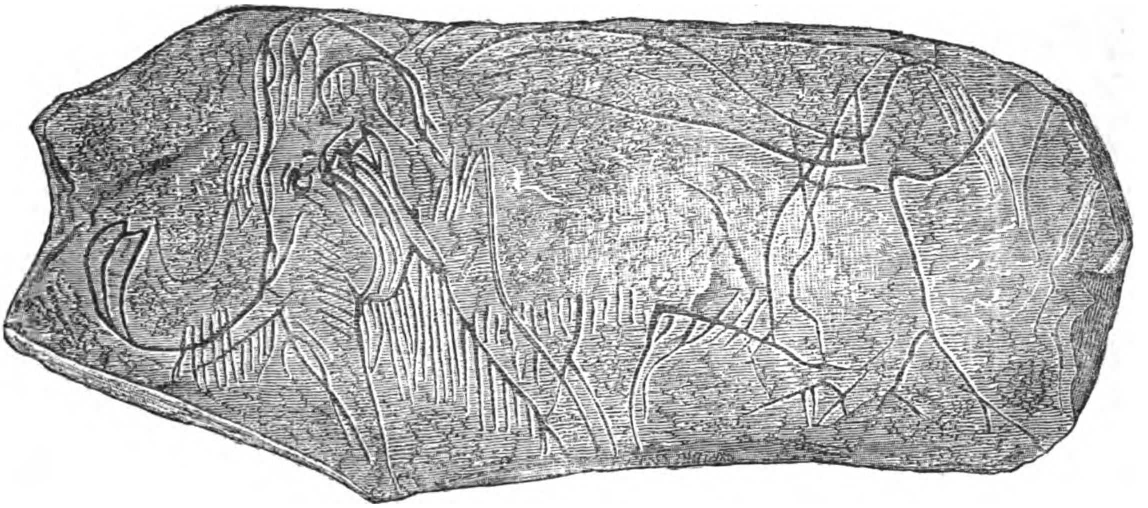

Fig. 12.—The Mammoth, carved on ivory. (Engraving from the Madelaine.

Among these remains of animals we still find the mammoth and the great cave lion; likewise a large bear, which might well be the *Ursus Spelæus*. We must likewise remember that the reindeer had not begun to multiply rapidly, that it was less plentiful than the horse; we are therefore still in the intermediate age. But, on arriving at the following stations, we enter definitely the Reindeer Age; henceforward the vestiges of this animal will be more abundant than those of all the others put together.

The finest works in flint of the Valley of the Vézère are those of Upper Laugerie. All the implements, all the weapons of that station are in flint. They are innumerable; their shapes and dimensions are very varied. Side by side with imperfectly fashioned objects we find others whose elegant form and delicately finished contours reveal accomplished workmen.

These beautiful flints of Upper Laugerie belong to the Solutré type. Their shape is lanceolated; they are not thick; their graduated edges, jagged with little notches, are regular and symmetrical; their base is often fashioned so as to facilitate putting on a handle. They are evidently destined to be adapted to the extremity of a piece of wood. Their dimensions vary considerably; the shape is much the same. It is easy to see that the small ones are arrow-points; the medium size doubtless furnished the darts which were hurled from the hand. The largest are lance-points, but their want of width shows that those lances were rather light.

These carefully-wrought points, so common at Upper Laugerie, are not to be found in the later stations of the valley of the Vézère. It was surmised, from this circumstance, that the workmanship of flints, after having progressed till the time of Upper Laugerie, had then declined. This caused surprise, and justly; for it would be astonishing if such an intelligent people, as were evidently the Troglodytes of the Reindeer Age, had allowed their main branch of industry to decay. But many objects found in their more recent stations prove that they had not lost the secret of fine carving; and that, if they no longer wrought the points of Upper Laugerie, they no longer needed them.

A great progressive stride had been accomplished. They had learned how to shape the deers' horns, and the bones of animals. It was with those substances, more pliable than flint, less hard, no doubt, but quite solid enough to fabricate darts and arrows of a longer flight and a greater precision. Then, when these modes of workmanship were once known, the bones and horns of deer were used to manufacture a vast number of tools and utensils of every description.

But, for all that, the reign of flint was not over. On the contrary, the varied assortment of cut flints was greater than ever; to those which served as weapons and implements were now added a multitude of small tools destined to use for working the deer-horn.

We have here arrived at an important evolution of industry. Up to that time there had only been simple industry, or as it were primitive, utilising the original substance direct. Now we come to progressive industry. Tools were manufactured whose sole use was to fabricate others.

In all ages flint had been employed as an instrument of workmanship. From the commencement of the Stone Age it had been used to cut the horn, to make pikes, clubs, handles of lances or darts. The idea of making use in the same manner of the bones of animals was not new either, for in the ancient station of Cromagnon were found some dart-points of deer-horn, and even some pieces of ivory. But the characteristic feature of the epoch on which we are entering was the creation of special tools which were not necessary for the wants of life, and which were destined to facilitate and perfect the fabrication of useful implements. From that time commenced that division of labour which, in a future day, was to increase a hundredfold the power of man and subject all nature to his sway.

The workmanship in deer-horn was already pretty far advanced in the station of Gorge d'Enfer. We find there a complete assortment of objects in this substance—lances, darts, arrows, bodkins, needles, hunting marks, account registers, &c. These articles are pretty well wrought, but without ornaments, and the darts are of the simplest shape. They are conical points, without any barbs. (See Fig. 11.)

The invention of barbs is worthy of attention. These recurring points no doubt rendered the blow more dangerous; the projectile remained fixed in the flesh, and the wounded animal could not get rid of it as he fled through the bushes. But this was probably not the principal object of the barbs. Placed in a regular series on both sides of the arrow (see Fig. 9), they sustained it in the air like wings; they increased the flight and the precision of the aim, and this innovation suggests a certain knowledge of experimental physics. The barbs are generally provided on one side with one or more openings, which are supposed to be destined for the reception of poison. The barb of the arrows and the ornamentation, more or less artistic, are the two distinguishing marks of the stations of the latest epoch. These are three in number—the Eyzies, Lower Laugerie, and the Madelaine. They resemble each other closely, and it is probable that they were nearly contemporary.

III. *The Society of the Troglodytes*

The caves of the Troglodytes were situated near the Vézère, without any special aspect, excepting perhaps that they were never open to the north.

They lived in them the whole year round. This is proved by the remains of their food, for they ate the reindeer fawn of every age. An examination of the teeth of these young animals, of their bones, of their horns in different stages of growth, enables us to determine the number of months they had lived, and consequently the season of the year in which they were killed. Hence we may aver that our Troglodytes had a fixed residence, in other words, that they were not nomads.

When they went out fishing or hunting they closed the mouth of their caves to prevent the entrance of carnivora. A single bone, found at the Madelaine, has the trace of a hyena's teeth. This animal may have once by accident gained an entrance. The hyena was rare at that epoch, but wolves and foxes were numerous, and if they did not come and gnaw the bones scattered all over the floor of the cave, it was because the latter was carefully closed. As there is no vestige of a stone door at the approach to our caves, the Troglodytes, doubtless, closed their doors with palisades.

There have certainly been found, in the three stations of the latest epoch, a certain number of stones in granite, sandstone, or quartz, rounded and polished nearly smooth with friction, presenting on side a very regular depression in the form of a little cup, and resembling little mortars. From this has arisen the supposition that the Troglodytes ground corn for food; but all concur in proving that they did not understand agriculture. It is much more probable that they used their mortars to triturate poisons or colours.

Hunting was their chief resource and occupation. The remnants of bones accumulated on the floor of their caves prove that they hunted animals of every size, from the small bird to the mammoth. This old giant of the early quaternary age still survived, but he was becoming very rare.

Here is the representation of a piece of ivory discovered in 1864, at the Madelaine, by MM. Ed. Lartet, de Verneuil, and Falconer. On this surface, an engraved drawing represents the mammoth, with his head erect, his brow concave, his great tusks bent, his small eye, his long trunk, his tail elevated, and his long mane. In a word, precisely like the mammoths in flesh and bones, which a perpetual frost has preserved to our own days on the banks of the Lena. (See Fig. 12.)

The Troglodytes of the Reindeer Age had rarely an opportunity of encountering the mammoth. They more frequently hunted the aurochs, the horse, the ox; and it was doubtless for hunting these large animals that they still had some large spears, armed with flint, differing little from those of Moustier. But nearly all their weapons were light, and the deer-horn points replaced the flint points of an earlier epoch.

The bow had become the predominant weapon, for henceforth nothing resisted man; all fled before him, and hunting was no longer a struggle but a chase. There were two kinds of arrows: the little pointed arrow, not barbed, for small animals and birds, and the large dart with two sets of barbs, which was principally used in hunting the reindeer. Light spears, terminating in a flattened point, darts with conical points, and long sharp poignards, which gave, when necessary, the finishing blow, completed the hunting equipment. I was nearly forgetting the rallying whistle. It was a reindeer's phalange, pierced near one end, with an oblique hole which did not go right through, and only penetrated to the medullary canal. By blowing on this hole as on a drilled key, one can, even to this day, extract shrill sounds.

(*To be continued.*)

THE NEW HYDROCARBON GAS

THE new hydrocarbon gas produced by Mr. Ruck's process certainly promises to realise the conception that has long floated in the minds of scientific men of turning the exhaustless store of heating power to account that lies ready to hand in water. Mr. Ruck appears literally, by the successful development of his invention, to have set the Thames on fire. At this present time, at the Battersea water-works, on the banks of the old river, near to Battersea Park, both light and heat may be seen and felt in the process of evolution from the decomposition of the water of its stream, and further light is added to the gas first produced by a very simple and uncostly extension of the process, until the illuminating power is raised to the intensity requisite for artificial lighting during the dark hours of the night. The Battersea water-works are now lit experimentally by this new form of gas, an apparatus having been erected there to test and prove the efficiency and value of the method.

Mr. Ruck's hydrocarbon gas, it should be at once understood, differs entirely from the so-called "air gases" that consist mainly of air impregnated with the vapour of some form of naphtha or petroleum, in the fact that its base is essentially a gas. The heating gas, which is the form first generated, is true honest hydrogen mingled with a little taint of carbonic oxide, and a small and practically unimportant percentage of carbonic acid; and the apparatus by which this heating gas is produced is remarkably ingenious and simple. Ordinary steam is brought through a pipe from one of the boilers of the engine house, and this steam is poured through a horse-shoe-shaped tube that passes through the red heat of a fierce coke furnace. In this tube it is superheated, or raised to a temperature which disposes its constituents, the oxygen and hydrogen, to dissolve their intimate alliance, and in that state it is passed on into retorts, also contained in a lower region of the same furnace, which are packed full of coke and fragments of iron. The steam is discharged into the interior of these retorts out of its own conducting pipe, so that it has to traverse their entire length amidst the masses of heated metal and coke, and during its journey it ceases to be steam. The oxygen attaches itself to the iron, and forms scales of black rust, and the hydrogen passes on free, with only a commingling with carbonic oxide and carbonic acid formed by the action of the disengaging oxygen upon the coke packing of the retort, and with certain sulphurous vapours that also issue from the coke. In this impure state the gas issues from the retort, and is carried to a purifying chamber containing oxide of iron, which at once clears it from all the sulphur compounds, and it is then stored in a gas reservoir of ordinary form. In this state it is the "heating gas;" that is, gas supereminently suited for all purposes where heat, without light, is required, as, for instance, for gas stoves of whatever kind, or for boiling water, and generating steam. When the gas is taken from this reservoir, and discharged through an ordinary burner, it burns with the pale colourless hydrogen flame, streaked with a few lines, of yellow scintillations, and of the characteristic pale green colour of incandescent carbonic oxide.

At the present time, with coals quoted in the London markets at 52*s.* per ton, this part of the affair, the production of a heating gas out of water, at the cost of a very simple apparatus, a very small consumption of fuel, and with a demand for an incredibly small application of manual labour, seems to be the one that is most deserving of thought and attention. In the practice of the manufacture at the Battersea water-works, by the expenditure of one ton of coke for the interior of the retorts, and of two tons of coke for the support of the heat of the furnace, 133,000 cubic feet of gas are produced, that, to say the least of it, is quite equal for all purposes of heating to coal gas in ordinary use, and that is as chemically enduring and perfect for storing in gasometers and for transmission to unlimited distances through pipes. In a direct experiment with the gas, tried by the writer, one quart of cold water was boiled in four minutes and a half by a jet of flame issuing from an orifice one-eighth of an inch in diameter, and under a pressure of three inches of water, without any arrangement for the concentration and protection of the flame from chill and draughts. There was no provision on hand to measure the exact consumption of the gas, but the man who was engaged in the Laboratory estimated it at about five cubic feet per hour. Now the cost of this gas at the works is found to be 7*d.* per 1,000 cubic feet. In this experiment, therefore, the result was something like converting seven gallons of water at a temperature of 38° Fahrenheit, into boiling water for 1*d.* One thousand cubic feet at a cost of 7*d.* would boil about 50 gallons of cold water. At the works at the present time the steam is supplied independently from the boiler of the engine room. But this does not need to be taken into consideration, because the waste heat of the retort furnace is more than enough for the production of the steam, and in ordinary circumstances will be used, as a matter of course, for the purpose.

When it is desired to use the gas for lighting purposes, it has to be further prepared and manipulated. The "heating gas" from the gasometer is made to bubble through a reservoir containing rectified petroleum at a specific gravity of about 0·680. It then passes at once into the pipes for circulation and consumption, and issues from these burners a very excellent gas, equal in illuminating power to 16½ candles with a consumption of 5 cubic feet an hour in an Argand burner. The cost of the gas in this form is a trifle less than 1*s.* 8*d.* per 1,000 cubic feet, and the saving in the manufacture over ordinary coal gas with coals costing 26*s.* per ton, is estimated to be 40 per cent.—in exact figures 1*s.* 8*d.* per 1,000 cubic feet against 2*s.* 4*d.* per 1,000 cubic feet. One thousand cubic feet of the heating gas require a gallon and a half of the petroleum to convert them into illuminating gas, but they are considerably increased in volume by the conversion—133,000 cubic feet of "heating gas" become 165,000 cubic feet of "illuminating gas" after it has been passed through the petroleum. Arrangements have been made for the purchase of several millions of tons of crude petroleum at a price which will represent a cost of 6*d.* a gallon after rectification.

Some rather severe experiments have been already tried to test the power of the illuminating gas to retain its full charge of carbon after travelling through long distances of delivery at low temperatures, and the report of the testing engineers is that so far the experiment was eminently satisfactory, and that there was no perceptible loss of illuminating power. Experiments on this point, however, and also upon the arrangements that will best enable the heating gas to be turned to account, are still in progress, and will afford ground for further notice in due time.

The furnace and retorts which are at work at Battersea are very compact, occupying about the space of an ordinary well-packed steam engine of 20 or 30 horse power. These retorts however are only in use for about two hours out of the twenty-four to supply the works with illumination, and it is estimated that they would be quite large enough to supply illuminating gas for the consumption of a small town of about 4,000 inhabitants. As regards the most important bearing of saving of manual labour it is found to amount to dispensing with the services of 29 labourers out of every 30 who are required in the old process of coal distillation. The charge of coke and iron which is now in the retorts yielding the gas at Battersea has not been changed, or renewed, for several weeks. The iron in the retorts is in the form of old chain, for the convenience of withdrawal, and seems to cover itself with thin black scales. The carbon in the interior of the retort is removed entirely by the gas as it is gradually converted in the process of manufacture into carbonic acid and carbonic oxide.

It may, perhaps, be well to remark that a process for the manufacture of "water gas" was presented by M. Gillard some fourteen years ago, in which superheated steam was decomposed in retorts by the action of incandescent charcoal; the carbonic acid, so formed, issued from the retort with the hydrogen, and was afterwards removed in a special purifier. Lighting power was secured by heating platinum wire in the flame. The distinctive features of Mr. Ruck's process are—the decomposition of the superheated flame by coke and iron, which remain long periods in the retorts without change; the removal of sulphur products by oxide of iron; and the carbonising for illumination by passing the hydrogen through rectified petroleum.

HUNTERIAN LECTURES BY PROF. FLOWER

LECTURES I. II. III.

IN considering the various formations which compose the earth's crust, it is unnecessary, whilst speaking of the mammalia, to refer to rocks lower than those of the secondary formation, for no palæozoic mammals are known. Respecting the value of palæontology in supporting or disproving the various theories at present in vogue regarding the origin of life, the details of the course will supply evidence of value. The amount of "the imperfection of the geological record" will be demonstrated in the classes considered. The extreme unlikelihood of any aërial animals being preserved in the fossil state is scarcely realised by many, nor is the smallness of the extent of the surface of the earth which has been examined. An accidental discovery like that in the upper oolite, of an extremely small deposit containing numerous marsupial remains, has done more to throw light on the subject than many more painstaking researches over larger fields. These facts being taken into consideration, it is clear that if it can be shown that the examination of fossil remains indicates only a tendency towards the filling of the gaps between existing groups, the tendency will be strongly in favour of evolution; but if it brings to light nothing but types which are entirely new, the doctrine of special creations will be supported. Prof. Huxley has been able to show many of the transitions between reptiles and birds, and Prof. Marsh's new discovery of *Odontornis* is an important addition. It is among mammalia that in the present state of our knowledge there are the greatest gaps. The relations of the Cheiroptera are indeterminable, and so are those of the Edentata; not much is known of the Cetacea as regards their affinities, though they may be near the seals on the other hand. The Ungulata constitute a group in which the considerable gaps between existing types are almost completely removed by the study of fossil forms. Taking first the Perissodactylata, in the Pliocene, Equidæ abounded in America as well as in the Old World. Tapirs and Rhinoceroses were equally abundant; these are the remnants of a large group which is probably becoming extinct, as it is indicated by the fact that the species are becoming less numerous. A little further back we find Hipparion with rudimentary side toes. In the Miocene and upper Eocene, Anchitherium and Palæotherium represent the group, though the latter is peculiar in its teeth. Fossil Rhinoceroses have larger teeth and no horn, some possess incisors, and the other teeth less specialised. The Tapir stands much by itself, and an ancient type containing Lophiodon and Hyracotherium seems to be now unrepresented. Again, among the Artiodactylates, *Chæropotamus* and *Hyopotamus* as far back as the Eocene are the most generalised, and from them as we ascend in the series the differentiation towards existing types becomes more and more evident. Among these later forms the North American *Oreodon*, which has been obtained in such great numbers, tends to the ruminants, but possessed upper incisors and canines. The Miocene of France and Germany affords very similar evidence. It is also interesting to note that the further we go back, the more do the individuals of the Perissodactylate group approach the Artiodactylates, but as yet no connecting link has been obtained. The Proboscidia, animals first appearing in the Miocene, approach in the older forms to the Ungulata, and Prof. Marsh's newly discovered Dinoceras seems to help to fill the gap.

In reviewing the various strata which are found to contain remains of mammalia, those of the quaternary or post-pliocene period are rich in species not far removed from existing forms. In most countries where limestone rocks exist, caverns are found containing large numbers of bones, such as those of Kirkdale, Liege, and Gibraltar, the last having been lately explored by Mr. Busk. Those of the Wellington Valley in Australia have afforded numerous remains of marsupials, showing that those animals have been located there for a considerable period. Again from the Pampas of South America many of the valuable skeletons which enrich the collection of the College of Surgeons have been obtained. The Miocene formation is particularly interesting from the richness of its fauna. *Dinotherium* and *Mastodon* being obtained in South France, as well as at Pikermé in Greece, where they are associated with *Hipparion*, the giraffe and others. Belonging to the same formation are the strata of the Siwalik Hills of India, which abound in hoofed animals, and have been so well worked out by Dr. Falconer. The peculiar mammalia of the territory of Nebraska, at the foot of the Rocky Mountains, belongs to the same age. In the Eocene period lived the animals so fully described by Cuvier, *Palæotherium*, *Anoplotherium*, &c. Besides in the Paris basin, similar strata occur at Hordwell, in Hants, and at Binstead, Bembridge, and Headon, in the Isle of Wight. In the London Clay of Sheppey *Hyracotherium* and *Lophiod n* are found.

Early in this century, it was supposed that mammalia were not present in the secondary rocks; but this was shown to be incorrect. In 1847, Prof. Plieninger discovered in some Triassic sand he was sifting a minute tooth with double fangs, probably belonging to some marsupial animal, which he named *Microlestes*. Prof. Owen considers it to be related to *Myrmecobius*. Similar teeth from the Rhaetic beds have been discovered by Mr. C. Moore, of Bath. An equally minute Triassic tooth was found by Mr. Boyd, Dawkins at Watchet, in Somersetshire, and from its slight resemblance to that of *Hypsiprymnus* it has been named

Hypsibrymnopsis. Among the coal fields, probably of the Trias Age, in North Carolina, the late Prof. Emmons obtained the lower jaws of three insectivorous or carnivorous animals, with the following dental formula—i. 3, c. 1, p.m. 3, m. 7, and, as Prof. Owen has pointed out, this large development of the molar series approximates it to *Myrmecobius*. A peculiarity of these jaws, as of all others from the secondary formations, is that a long groove runs along their inner side in the position of the mylo-hyoid groove of recent mammals; this is only a result of arrested development round Meckel's cartilage, and it does not indicate—as has been supposed by some—reptilian affinities, there not being any signs of more than two centres of ossification. So early as 1812, a man working in the Lower Oolite of Stonefield found a perfect lower jaw one inch long. This was taken to Mr. Broderip and Mr. Buckland; Cuvier also had an opportunity of seeing it, and called it an opossum. Dr. Blainville thought that it was reptilian, and called it *Amphitherium*. Owen clearly proved that it was marsupial, the angle being inflected. The dental formula is i. 3, c. 1, m. 12, and the shape of the teeth indicates an insectivorous or carnivorous diet. *Phascolotherium*, another genus from the same slates, has the formula i. 3, c. 1, m. 7, which, if it had one more incisor, would be like that of the opossum. Higher up in the secondary formation, in the Purbeck, Mr. Brodie obtained several small jaws from Durdlestone Bay, near Swanage. Mr. Beccles thoroughly explored this bed, and very valuable results have been obtained, more than forty jaws, nearly all lower, of twenty-four species belonging to ten genera, having been described by Owen.

NOTES

By five decrees of the French government, dated February 13, the working of the French observatories has been thoroughly reorganised, and if the new system is faithfully carried out, we have no doubt it will be productive of good results. The management of the government observatories is entrusted to a body of astronomers responsible to the Minister of Public Instruction, and consisting of titular astronomers (*astronomes titulaires*), associate astronomers (*astronomes adjoints*), and assistant astronomers. This *personnel* is distributed among the various observatories according to the requirements of the service, and the special resources offered by each establishment for the researches of observers. The staff of the observatory of Paris consists of a director, six titular astronomers, ten associate astronomers, and several assistants. A responsible secretary is attached to the establishment. The Paris observatory has a scientific council, composed of the director, the various chief astronomers of the service, and of six councillors of the observatory, chosen from among scientific men eminent in mathematics, astronomy, or physics, and of whom four at least must belong to the Academy of Sciences or to the Bureau des Longitudes. These are to be nominated by decree, in accordance with the advice of the Council, and upon the proposal of the Minister. The Council is to meet once a month, and every year, at Easter, the directors, the councillors, and the chiefs of the various scientific establishments, meet in general assembly with the Minister of Public Instruction. The directors and the titular astronomers are appointed by the President of the Republic, acting according to the advice of the General Assembly. The salaries of the titular astronomers vary from 6000 to 8000 francs, those of the associate astronomers, divided into three classes, from 3,500 to 6,000 francs, and those of the assistant astronomers, also divided into three classes, from 1,000 to 3,500 francs. These salaries do not strike us as being particularly liberal. By a second decree, M. Le Verrier has been made Director of the Paris Observatory; the Councillors of the Observatory are, MM. Belgrand, Fizeau, Vice-Admiral Jurien de la Gravière, Janssen, Tresca, Daubrée; and Members of Council, MM. Yvon Villarceau, Wolf, Gaillot, and Rayet. M. Marie Davy is appointed Director of the Meteorological Observatory of Montsourris, and M. Stephan of the Observatory of Marseilles.

The arrangement of the buildings in which the Annual International Exhibitions are held, makes it almost essential for their success that visitors should be able to pass from one side to the other across the gardens of the Royal Horticultural Society. A large body of the Fellows, however, more especially those residing in the neighbourhood, object to the admission of the exhibition visitors, as an infringement upon the privacy of the gardens. At the late adjourned annual meeting there was a very stormy discussion upon the subject, and the report of the Council recommending a continuance of the policy of meeting the views of the managers of the exhibitions was rejected by a large majority. The Council thereupon expressed their intention of resigning; but this, it appears, they have no legal power to do till the expiration of their term of office.

Captain M. F. Maury, the well-known American hydrographer, died on February 1, at Lexington, Virginia, at the age of sixty-six years.

The *Times* announces that the Council of the Royal Society are about to nominate Dr. Hooker as President of the Society, in succession to Sir George B. Airy, who retires from the chair at the Society's anniversary in November next.

It is announced in a "cable" telegram from America to the Astronomer Royal, that a new planet (130) was discovered by Peters on February 18. It is of the eleventh magnitude, and was moving rapidly towards the north. R. A., 10h. 0m., Decl., 13° 40′ N.

Mr. T. M'Kenna Hughes, M.A., of Trinity College, has been elected Woodwardian Professor of Geology at Cambridge, in succession to the late Prof. Sedgwick. Originally there were nine candidates, but most of them retired before the poll, and the real contest lay between Mr. Hughes and Mr. Bonney, a Senior Fellow of St. John's, the numbers at the close being 112 and 105 respectively.

By a resolution of the Board of Trinity College, Dublin, the Natural Sciences have been introduced into the Undergraduate Course. Hitherto a student might select the Natural Science Course for his final examination in Arts, obtaining a senior or junior Moderatorship, according to his answering; now having once passed his "little go," the student may in his third year select for his term Lectures and Examinations, Botany and Zoology; and in his fourth year Physical Geography and Palæontology. For this purpose the following courses of lectures have been arranged:—Michaelmas Term—Prof. Haughton, M.D. F.R.S., lectures on Physical Geography; Prof. E. Perceval Wright, M.D. on Histological Botany; Prof. Macalister, M.D. on Vertebrata. Hilary Term—Prof. Haughton on Palæontology; Prof. Wright on Cryptogamia; Prof. Macalister on Mollusca and Arthropoda. Trinity Term—Prof. Haughton on Palæontology; Prof. Wright on Phanerogamia; Prof. Macalister on Annulosa, Cœlenterata and Polyzoa. In addition, in Trinity Term, Demonstrations are given by the several Professors in Palæontology, Comparative Anatomy, and Botany.

At the Fellowship Examination at Trinity College, Cambridge, in 1874, a Fellowship will be obtainable by adequate proficiency in Natural Science. The Examination, which will take place in the end of September or the beginning of October, will be chiefly in Chemistry, Physics, and Biology, and in the subjects of any papers which may have been sent in. Candidates are invited to send in to the Examiners (care of Mr. Trotter), on or before May 15, 1874, any papers which they may have published containing original observations or experiments, or discussions of scientific questions, or any similar matter in manuscript. The papers may be on any branch of Natural Science which is not strictly medical. They must be accompanied by a statement as to what portions of the matter are claimed as original, and of the sources from which the rest is derived so far as they are not explicitly stated in the paper itself. Candidates will be liable to be examined in the subjects of their papers, and in matters connected with them, or in the branches of science to which they refer. This Fellowship will be open to all Bachelors of Arts, Bachelors of Law, and Bachelors of Medicine of the University, whose standing after their first degree does not exceed three years. Candidates who are not members of the College must send their names to the Master on or before September 15, accompanied by certificates of good character. For further information, apply to the Rev. Coutts Trotter, Tutor of Trinity.

M. RENÉ DE BREBISSON writing under date of February 16 to the Secretary of the Dublin Microscopical Club, mentions that while the smaller collections of Algæ belonging to his late distinguished father, had for some time past been disposed of, yet the large collection of Diatomaceæ was still for sale. This collection contains (1) 8,000 prepared slides, some in fluid, but the greater part by far in Canada Balsam; (2) about 600 tubes and bottles of Diatoms in alcohol ready for mounting; and (3) a collection of Diatoms on mica and some few on paper. These collections contain the types of most of the species described by De Brebisson, Kutzing, Smith, Ralfs, Grunow, W. Arnott, De Notaris, &c. &c. The price asked is 10,000 francs, but possibly for a public collection 8,000 francs might be taken. The collection is well worthy the attention of botanists, and we hope soon to be able to report that it has been disposed of.

THE Royal Dublin Society has inaugurated a course of lectures on subjects connected with public health, in the arrangement of which the Dublin Sanitary Association afforded its advice and assistance; the first of the series, being Introductory, was delivered on Saturday, Feb. 22, by Dr. W. Stokes, F.R.S., and the remaining ten will be delivered each Saturday until completed. The Subjects and Lecturers are as follows:—On the discrimination of Unadulterated Food, by Dr. J. Emerson Reynolds. On Meteorology in its bearing on Health and Disease, by Dr. T. W. Moore. On the Geographical Distribution of Disease, by Dr. T. Little. On Zymotic and Preventible Diseases, by Dr. T. Grimshaw. On liability to Disease, by Dr. Alfred Hudson. On Antiseptics and Disinfection, by Dr. R. Macdonnell, F.R.S. The Prevention of Artisans' Diseases, by Dr. E. D. Mapother. On the Contagion Theory of Epidemics, by Rev. Dr. Haughton, F.R.S. On the Construction of Dwelling Houses, with reference to their Sanitary arrangement, by Mr. G. C. Henderson; and on Sanitary Legislation, by Mr. R. O. B. Furlong.

WE understand that the delay which has occurred in the issue of the volume of the *Zoological Record* for 1871, has been caused by the illness of one of the contributors to the Invertebrate section. At a recent meeting of the Council of the Zoological Record Association it was determined to issue the portion of the volume already completed (down to the end of the Insecta) immediately, leaving the remaining section until the health of the contributor allows of its completion.

PROF. GIGLIOLI, of Florence, has lately re-examined the skull of the Chimpanzee of East Africa, which was obtained some years ago from the Upper White Nile, and was formerly in the Museum of the School of Medicine of Cairo, and has come to the conclusion that it belongs to a new species which he proposes to call *Troglodytes Schweinfurthii*, after the well-known African traveller of that name.

THE Royal Zoological Society of Ireland has just issued its forty-first annual Report. It would appear that the Gardens were visited during 1872 by 147,184 persons, being nearly 20,000 less than 1871; but this is abundantly accounted for by the extreme wetness of the past year. Perhaps the most interesting addition to the Garden during that period consisted of two living specimens of the Climbing Perch of India (*Anabas scandens*); these were presented by Staff-Surgeon Dobson of Calcutta.

WE have received from Mr. Roosevelt, the secretary, the third and fourth annual Reports of the American Museum of Natural History, from which we learn that this newly founded national collection, situated in Central Park, New York, is being conducted with an enterprise and discretion which, if continued, will shortly render it worthy of the capital it represents. Frequently during the last year it was visited by more than 10,000 people in one day, and every encouragement is given to students of science. Among the most valuable donations during the last two years is a great Auk, presented by Mr. R. L. Stuart, and a large collection of insects from Madame Verreaux, of Paris.

PROF. TYNDALL arrived at Liverpool on the 19th inst., in the *Cuba*.

AT Thorn, in Prussia, where he was born in 1473, the four hundredth anniversary of the birthday of Copernicus was celebrated on February 19. Speeches were delivered by several scientific men, and a ball was given in the town hall.

ACCORDING to the accounts we have as yet seen of the Samos earthquake it was of a remarkable character. It affected chiefly the pretty little capital of Vathy. The shocks were not felt throughout the island, but only on the coast between Kotzika and Pagonda. Nevertheless a counter shock was felt as far off as Smyrna. So far as we can make out, the first shock, which was the strongest, was felt at 1 A.M. Up to Feb. 3, 104 shocks had been felt at intervals, 4 or 5 very strong and threatening.

THE Smyrna earthquake was on Feb. 1 or Jan. 31 at night, and was violent. The oscillation is reported as from S.W. to N.E.

THE weather in Yanina, in Epirus, up to the beginning of February, had been most remarkable. There had been great rains, and the fruit trees had already yielded fruit. In the neighbouring provinces of Bosnia and Prizrend the fruit trees had also blossomed in full winter, and some had given fruit. The like is reported from Verzin, where plum trees, pears and figs had produced fruit of good quality.

A COAL mine has been discovered in the Bagdad district between Yezireh and Zeto. According to the report of M. Mougel, engineer to the viceroyalty, the formation extends over a length of more than four miles with a breadth of from 400 to 450 feet. About 84 tons were got out in the first three weeks.

WE have received from Dr. Petermann a beautifully executed map of South-west Germany, with Alsace and Lorraine as they existed before the outbreak of the French Revolution in 1789.

WE learn from the *Times of India* that the Bombay Geographical Society has been formally amalgamated with the local branch of the Royal Asiatic Society.

WE learn from the *Garden* that an American has made an experiment with the view of ascertaining how far soil is protected from cold by snow. For four successive winter days, there being four inches of snow on a level, he found the average temperature immediately above the snow 14° below zero; immediately beneath, 10° above zero; and under a drift 2 ft. deep, 27° above zero.

*PROFESSOR RAMSAY ON LAKES**

II.

III.—*The Waters of the Cambrian and Silurian Epochs and the Lakes of the Old Red Sandstone*

THE lecturer first briefly summarised the reasoning and the conclusions contained in his two preceding lectures on the origin of fresh and salt water lakes, and then proceeded to apply them to explain certain phenomena of the above geological epochs as deduced from the rocks belonging to those periods. He was about to endeavour to prove that certain of the formations included in a table of the stratified rocks were not formed in the open sea as usually supposed, but were formed in great lakes. The small numbers of fossil shells found in fresh-water strata and in some cases their total absence rendered absolute demonstration very difficult. The Cambrian strata, seen in England, in North Wales, Shropshire, and other parts consist of red and mottled sandstones and slates, and contain but few fossils; trilobites and one or two fossil shells have been found, not in the red strata, however, but in blue and grey shales. Above these the Lingula flags (a member of the Lower Silurian) contain fossils in great numbers, and of such creatures as must have lived in the open ocean of that period. In the Upper Silurian, too, fossils are very numerous, and all inhabitants of the sea. But above these, in the Old Red sandstone, the numbers have declined both in genera and species and individuals, and the shells, &c., which remain are small and dwarfed in size. Yet the strata of the Old Red sandstone lie conformably on the Upper Silurian, showing that the passage from the one set of beds to the other was gradual, and the change in the fossils is likewise gradual.

The Old Red strata consist of red sandstones (forming about two-thirds of the whole strata) and a red marl developed in England, in South Wales, Herefordshire, &c., throughout the whole of these strata fossils are very scarce, chiefly occurring in the uppermost and lowermost portion. In the Ludlow rocks, at the upper portion of the Silurian strata, are found fragments of stones and seed vessels of land plants for the first time. Not that land plants did not exist before that period; the lecturer thought they had done so, but that their remains were not preserved in the rocks, inasmuch as they had been formed in the open sea, far from land. But their occurrence in the Ludlow rocks evidently proves that those strata, although truly marine, were formed in the neighbourhood of land, and, as the lecturer believed, in waters more or less land-locked. These passage beds also contain the remains of fish of various genera—Cephalaspis, Onchus, &c. But passing upwards into the beds of the Old Red sandstone, the fish which occur have their nearest living analogies in inland fresh-water areas; *e.g.* the Lepidosteus of the North American rivers, the Polypterus of the Nile, and the recently discovered Ceratodus in the rivers of Australia. Large crustaceans—Eurypterus and Pterygotus—occur higher up in the formation, and in all cases where they are found, and in the majority of cases where fish are found in these strata, shells are not associated with them. Hence from the absence of shells, and their dwarfed forms when they do occur, especially as compared with the underlying Silurian beds, and from the presence of those peculiar kinds of fish, we are entitled to infer that the strata were deposited in inland lakes. Again, examination of a piece of the red sandstone will show it to be composed of a number of minute grains, each surrounded by a thin pellicle of peroxide of iron, to which the red colour of the rock is due, for when this iron is discharged by chemical means the rock remains purely white. All truly marine rocks that we know are in no case coloured red; they are black, blue, green, or yellowish, but never red, and there is no reason why in the sea iron should be deposited as a peroxide. But in certain lakes in Sweden there is a constant deposit of iron oxide; and though this is due to organic agency, still it occurs in lakes, but never in the sea. The Old Red sandstone is not a wide-spread formation, but has more of a local character.

The lecturer then showed by means of diagrams how he conceived that certain areas of the Silurian seas might be isolated and shut off from the ocean by elevation and depression of the land, that the gradual freshening of these inland areas would result in dwarfing and deforming the marine creatures in the waters, and rendering them gradually extinct. The lakes in the north of Europe, which must have been filled with sea-water just after the glacial epoch, are similar cases, for in some of them the marine forms are not yet totally extinct, but have become partly acclimatised, and so the occurrence of a few such forms in these rocks is no conclusive evidence against their being formed in inland and fresh-water lakes, but rather the contrary. At the top of the Old Red sandstone beds land-plants and fresh-water shells occur. In the north of Scotland the Old Red sandstone rocks are well developed, the Grampians at that time standing out of the waters. The bottom bed is a clay with angular boulders, much resembling the "boulder clay" formation, and evidently of glacial origin, and though the lecturer dare not assert that glaciers scooped out the lakes in which the rocks were deposited, still it was very interesting to have evidence of their connection with those lakes. He likewise pointed out that if this theory of the lake origin of certain formations, first suggested by Mr. Godwin Austen, were established, it would open out an entirely new field of geological research by revealing to us the conditions not only of the ancient seas, but also of old continental areas.

IV.—*Salt Lakes of the Permian Epoch*

Prof. Ramsay first explained that it was necessary, in attempting to demonstrate the truth of his assertions as to certain formations having been deposited in inland waters to commence by considering the conditions of the preceding epoch, and trace the gradual change in the deposits resulting from the changed conditions. He therefore commenced by describing somewhat fully the rocks belonging to the carboniferous formation. The mountain limestone or carboniferous limestone, which lies at the base of the system in the south of England, is a nearly pure limestone, composed almost entirely of encrinites, corals, and other similar marine forms, and attaining a thickness of two or three thousand feet. Above that lies the millstone grit, about a thousand feet thick, likewise marine, but containing the remains of land plants; overlying that are the coal measures, consisting of an alternation of beds of sandstone, slate, coal, and ironstone. In the north of England and Scotland the base of the system consists of alternating beds of limestone, sandstone, and shale, with occasional beds of coal, and above that the true coal measures. The coal was formed by the life and death of land-plants—Lepidodendron, Sigillaria, Calamites, &c., and under every bed of coal is a layer of clay—"underclay," which is nothing more nor less than the ancient soil on which the plants grew, and contains the roots of some of the above plants, *e.g.* Stigmaria, the root of Sigillaria. The remains of the plants accumulated somewhat like existing peat bogs, and were at times submerged and covered with a layer of sediment, and again upheaved and overspread by vegetation. There must have been a large continental area in the latitude in which Britain now stands to furnish the gigantic rivers at the mouths of which many of these coal-measure forests grew.

Above the carboniferous strata lie the Permian seen surrounding some of the Midland coal fields, in a strip from Derbyshire into Cumberland, and forming the base rocks of a portion of the Vale of Eden. The beds lie unconformably on or against the coal measures, implying that a vast lapse of time, sufficient to allow for the denudation of thousands of feet of thickness of strata in some places, took place between the deposition of the two formations. At the base of the Permian strata lie beds of red conglomerate, sandstone, and marl, known on the Continent as *Rothliegende*; and above those lie the magnesian limestone. In the magnesian limestone a considerable number of marine forms of life occur, but compared with the great abundance of those forms in the carboniferous limestone, the fauna seems poor and the individuals are dwarfed; out of 1800 species of shells in the carboniferous genera only 38 genera and 180 species are found in the magnesian limestone. The latter strata also contain some fossil fish in its lower beds (marl slate), of the same genera as those found in carboniferous strata, and some show considerable resemblance to those living forms inhabiting inland fresh-water areas, mentioned in the last lecture. And there are various reptiles found—Labyrinthodont reptiles—which were truly amphibious, and which in some cases have left their skeletons, but far more frequently their foot-marks impressed upon the soft mud of some ancient shore, which likewise shows occasionally rain marks and sun cracks. Some of the reptiles belong to the Protosaurian genus, closely allied to the modern crocodiles or Thecodont saurians, and therefore probably ultimately connected with the land. And a very significant point in regard to the origin of these rocks is their chemical composition, the magnesian limestone consisting of the carbonates of lime and magnesia, often in about equal proportions. Now limestone is formed from the sea-water by the agency of animals, but no creature is known which secretes carbonate of magnesia from the sea waters to make its skeleton, and therefore we may conclude that it was precipitated from chemical solutions; and this could not take place in the open sea, but must have occurred, as in the case of rock-salt in confined inland waters. It is probable that by extensive changes in physical geography, large areas of the ocean were shut off, and in the lakes thus formed, the Permian rocks were deposited, the magnesian limestone being formed by the mixture of the carbonate of magnesia, precipitated by means of evaporation with limestone built up by organic agency. Crystals of gypsum too occur in these rocks, and pseudomorphous crystals of rock-salt pointing to evaporation, and consequently concentration of these salts in the waters of confined areas. A thin pellicle of peroxide of iron surrounds the grains in the sandstone and marl, which gives the red colour to the rocks, and which peroxide was formed by the reduction of the carbonate of iron, carried into the lakes by the rivers, by means of the oxygen of the air. The lecturer had no hesitation in saying that in all those formations which we know to be truly marine, the rocks are never red. So that from the paucity or absence of shells, from the remains of terrestrial or amphibious reptiles, and their foot-prints, from the occasional presence of true land plants (of the same genera, but not the same species, as in the carboniferous rocks), from the chemical composition of the rocks, from the presence of peroxide of iron, and from the presence of chemical precepitates, we are justified in concluding that the Permian rocks were deposited in great salt lakes, though perhaps not salt in every case. And a reflex of the conditions under which they were deposited may be seen in the state of the Caspian Sea (with a marine fauna like the North Sea, though the species are few and dwarfed), and of the salt lakes of Asia.

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* Continued from p. 313.

SCIENTIFIC SERIALS

THE *Lens* for November 1872, contains the following communications: "The preparation of Diatomaceæ," Christopher Johnstone, M.D.: a succinct account of the most usual and approved methods of cleaning Diatomaceous deposits. A short reply of Dr. J. J. Woodward to Dr. Lionel S. Beale; and a memorandum by Chas. Stodder, entitled "Draw-tubes *v.* Deep-eye-pieces." A continuation by Dr. J. N. Danforth of his communication on "the cell," treats of the theories of cell development. H. H. Babcock's "Flora of Chicago and its vicinity," Part IV. completes, we presume, the phanerogamic plants of Part III.; "Microscopical Memoranda for the use of Practitioners of Medicine," by Dr. J. J. Woodward, relates the results of the author's experience on "the Imbibition of the Tissues with Chloride of Gold and Osmic Acid." Prof. H. L. Smith gives a brief notice of the Bailey Collection of Diatomaceæ in the Museum of the Boston Society of Natural History. Dr. J. J. Woodward also advocates the employment of *Frussulia Saxonica* as a test of high-power definition in preference to *Amphipleura pellucida*. S. A. Briggs gives an enumeration of some of the Diatomaceæ of Upper Lake Huron and the Sault. The usual brief notes, with title-page and index, complete this number and the first volume of this American Quarterly Journal of Microscopy.

La Belgique Horticole, gives a short life of Redonté, the celebrated French painter of flowers. A description of a new tea rose, the "Pearl of Lyons," contains a short history of these plants, from which we learn that they were introduced into Europe in 1793 by an Englishman, Mr. Parsons, and reintroduced early in this century by others, Sir A. Hume being one of them. M. E. Morren describes, in a very clear and concise manner, the physiology of the nutrition of plants.

THE *Revue Bibliographique Universelle* contains short reviews of several botanical works, including that by Grisebach and Engelman, on the geographical distribution of plants, in which the world is divided into twenty-four botanical regions, several of these being, according to the reviewer, unnecessary. Referring to a work by M. Hamilton on the Botany of the Bible, the following occurs:—"Il a joint à chacun de ses articles une photographie prise sur nature, mais malheureusement dans les environs de Nice, et non point en Terre Sainte." Prof. Balfour's Introduction to the Study of Palæontological Botany is considered too deficient in detail and from the fewness of the references to other authors, the incompleteness of the Edinburgh libraries is presumed.

SOCIETIES AND ACADEMIES

LONDON

London Mathematical Society, Feb 13.—Dr. Hirst, president, in the chair. The following papers were read:—Prof. H. G. Smith, on the higher singularities of plane curves, and on systems of linear consequences.—Mr. J. Macleod, on the application of the hodograph to the solution of problems on projectiles.

Geologists' Association, February 1.—Henry Woodward, F.G.S., president, in the chair.—"On the Diprionidæ of the Moffat Shale," by Charles Lapworth, F.G.S. After reviewing the history of investigation among the biserial *Graptolites*, and the antagonistic opinions regarding their internal structure held by different palæontologists, the author stated that a careful decomposition and examination of specimen of *Chinacograptus* from the Moffat Shale, preserved in a state of relief, had forced him to the conclusion that the view of the duplicate nature of the polypary in this genus advocated by Professor Nicholson is substantially correct. The internal characters are identical with those in *Diplograptus*. The diprionidian polypary is in reality composed of two complete monoprionidian polyparies (each with its own cænosarc, virgula, and distinct hydrotheæ), placed back to back and coalescing along their flattened dorsal walls. There is certain evidence that this type of structure obtains among all, or nearly all, of the Moffat *Chinaeograpti*. Nevertheless, he was not prepared to deny the accuracy of Professor Hall's interpretation of the internal characters of his *China*(?)*typicalis*. As long as a single doubt remained upon this point, it was argued that it would be unsafe to exclude *Retiolites* and its allies from the *Dipliotidæ*, which might meanwhile be considered as embracing three sub-families, *Diplograptidæ*, *Retiolitidæ*, and a third and intermediate sub-family, of which *C.*(?) *typicalis* is the only known example. The sub-family *Diplograptidæ* will include all those species at present referred to *Diplograptus* and *Chinacograptus*. Now that the type of structure in these two genera is proved to be identical, a new system of classification is necessary. The only remaining characters which can in all cases be employed for the purpose of separation at our command are the form of the polypary and the shape and arrangement of the hydrotheca. It was shown that the different species of the *Diplograptidæ* naturally arrange themselves into five groups, clearly individualised by striking distinctions in these characters. Each of these groups, it was contended, was of sufficient importance to be considered as forming a distinct and separate genus. In this way the genera *Climacograptus* (Hall) and *Cephalograptus* (Hopk.) would remain untouched, and the author suggested that the generic term *Diplograptus* (M'Coy) should be restricted in future to those species of which *Dip. folium* (His.) is the type, and he proposed two new genera, viz., *Orthograptus*, to include those species resembling *Dip quadrimucronatus* (Hall) and *Glyptograptus* for those formed after the pattern of *D. tamariosus* (Nich.). The second portion of the paper was devoted to a revision of the genera and species of Diplograptidæ found in the Moffat Shales, and the following new species were described:—*Orthograptus aculeatus*, *O. Carruthersi*, *O. fasilicus*, *O. Pageanus*, *O. explanatus*, *O. compactus*; *Glyptograptus gregarius*, *G. per excavatus*, *G. modestus*; *Chinacograptus styloidens*, *C. tubuliferus*, *C. Longicaudatus*, *C. Wilsoni*, *C. antiquus*, *C. brevicornis*, *C. mirabilis*.

Zoological Society, Feb. 18.—John Gould, F.R.S., V.P., in the chair.—The Secretary read a report on the additions that had been made to the Society's collection during the month of January, 1873. Amongst these were specially mentioned a pair of Fruit-Bats from Formosa, presented by the Rev. Mr. Ritchie of Takoo, and a tapir from Paraguay, which presented some points of distinction from the ordinary form of the American tapir.—Prof. Newton, F.R.S., V.P., exhibited a print by Adrian Collaert (*circa*, 1580) containing the figure of a bird, copied in Leguat's "Voyages" (1708), and mentioned by the latter under the name of the "*Géant*."—Extracts were read from a letter received from Dr. John Kirk, H. B. M. Consul at Zanzibar, respecting a female koodoo, and other antelopes, of which he had obtained specimens for the Society.—Mr. Garrod gave a notice of the death of a kangaroo in the Society's gardens, which had been caused by strangulation of the small intestine, produced by the folding of the elongate cæcum round a loop of the small intestine.—A communication was read from Prof. G. J. Allman, F.R.S., containing a report on the *Hydroida* collected during the two expeditions of H.M.S. *Porcupine* in 1869 and 1870.—Mr. W. K. Parker, F.R.S., read a memoir on Ægithognathous Birds, in which it was shown that the peculiar palatal structure of this group was met with in three stages. These might be denominated incomplete, complete, and compound Ægithognathism.—Mr. A. H. Garrod read some notes on the anatomy of the Binturong (*Arctictis binturong*) founded on the dissection of a male specimen of this animal which had recently died in the Society's Gardens.—Mr. E. L. Layard, H.B.M. Consul at Para, communicated some notes on Mr. E. W. H. Holdsworth's recently published catalogue of the birds found in Ceylon.—A communication was read from Mr. H. Adams, F.L.S., containing descriptions of eighteen new species of land and marine shells, the former from Borneo and the Island of Tobago, and the latter from Mauritius, the New Hebrides and the Persian Gulf. Mr. Adams proposed to establish a new sub-genus of *Helix*, under the name *Caldwellia*, for *H. philyrina*, Morel, and some allied species from Mauritius and the Isle of Bourbon.

Chemical Society, Feb. 20.—Dr. Frankland, F.R.S., president, in the chair. The first paper read after the usual business of the society had been transacted, was entitled "Solidification of nitrous oxide," by Mr. Wells. The gas having been previously liquefied by compression in a strong iron vessel, can be caused to solidify by the rapid evaporation of the liquid in a current of air. It somewhat resembles solid carbonic acid in appearance.—A paper on aurin, by Messrs. R. S. Dale and C. Schorlemmer, F.R.S., was then read, giving an account of the authors' investigation of the composition and chemical properties of this dye.—"Researches on the action of the copper-zinc couple on organic bodies, I. on iodide of ethyl," by J. H. Gladstone, F.R.S., and A. Tribe, was read by Dr. Gladstone; and the last communication, "On the determination of ammonia in the atmosphere," was read by the author, Mr. A. H. Smee, Jun. The method employed is to collect and examine the moisture condensed from the atmosphere, on the external surface of a suitable glass vessel filled with ice. The lecture was illustrated by carefully-made drawings of the magnified crystalline forms which are left on evaporating the liquid.

Royal Horticultural Society, Feb. 11.—Annual General Meeting.—Lord Henry G. Lennox, M.P., in the chair.—The Report of the Council stated that there were now 3,572 Fellows on the books. They thought that, notwithstanding that a portion of the Fellows preferred to have the Garden and Society kept distinct from the Exhibition, it was for the interest of the former that the two establishments should work harmoniously. They have accordingly done their best to make arrangements with Her Majesty's Commissioners for the present year. The nature of these arrangements appeared in a letter from the Commissioners appended to the Report. They excited a very stormy discussion, and the further consideration of the Report was referred to an adjourned meeting.

Feb. 12.—Scientific Committee.—Dr. Masters, F.R.S., in the chair.—A letter was read from Col. Jervoise, stating that the two plants of *Agave Americana* which had flowered during the past summer were 23 years old in 1797. The presence of the *Phylloxera vastatrix* on vines about London was stated as having been ascertained without doubt. A discussion then took place on a letter from Major-General Cotton as to the best means of arresting a belt of moving sand which threatens the destruction of Beyrout. General Meeting.—Mr. Wilson Saunders, F.R.S., in the chair.—The Rev. M. J. Berkeley commented on a fine specimen of *Vanda Cathcarti*, which, though a native of the hot valleys of Sikkim, was found to succeed best under a cool treatment. A seed-pod of *Yucca Draconis*, sent by Mr. Wilson Saunders, was noteworthy, because Yuccas rarely fruited in this country.

Feb. 18.—Adjourned Annual General Meeting.—Mr. Wilson Saunders, F.R.S., in the chair.—The consideration of the Report of the Council was resumed. A letter was read from the Commissioners reverting to the subsisting agreement between them and the Society. On the motion of Sir Alfred Slade, the Report of the Council was not adopted. The Council then intimated their intention of resigning, and the meeting again adjourned.

PHILADELPHIA

American Philosophical Society, March 15, 1872.—A paper by Prof. Daniel Kirkwood was read, entitled "On some remarkable relations between the mean motions of Jupiter, Saturn, Uranus, and Neptune."

April 15.—On the Magnetism of Rocks of the Marquette group, by Prof. F. B. Brooks, State Geologist of Michigan. Beds of this formation were shown to possess such an influence on the needle, as to be correctly located by it, even when at considerable depths.—Prof. Pliny E. Chase presented numerous new relations which he had obtained by his method of comparing molar and molecular forces. He showed that the principal maxima of the annual auroral curve follow the principal annual meteoric displays; that all the primary planets are arranged near centres of inertia, or centres of primary or secondary oscillation; that superficial gravity both at Jupiter and at the earth, acting against orbital force for a half-rotation, gives a velocity nearly equivalent to that of a planet revolving at the sun's surface; that solar gravity under the same circumstances gives the velocity of light; that the sun-spot period is governed by the centre of gyration of the planetary system; that polarity is a necessary consequence of a rotating uniformly elastic fluid; that the elasticity of hydrogen is nearly perfect, and that, therefore, its density is, approximately, 54,130,000,000 times as great as that of the luminiferous æther. He also gave several additional physical approximations to the sun's distance, all of which are within the limits of the best recent astronomical estimates.

May 3.—Prof. Rogers described a new form of galvanic battery.—Prof. Lesley described a fault in the Unaka Mountains, on the Nolichucky River in East Tennessee.—Prof. E. D. Cope made some observations on the life of the Wyandotte Cave, Indiana.

May 17.—Prof. Chase exhibited an annual auroral curve, and explained its relations to the periodic maxima and minima of meteoric displays, &c. He then presented a number of tables expressive of recent calculated planetary relationships.—Prof. Rogers explained his manner of obtaining an unlimited supply of electricity from a high-pressure steam jet, not insulated and in all weathers.—Dr. Emerson and Mr. Trego described the destruction of *Abies excelsa*, *Maclura*, and *Thuja* during the preceding winter as far south as lat. 40° —Prof. Blodget described the meteorology of March 5, 6, and 7, during which a dry cold gale prevailed. In the succeeding spring fruit trees exhibited an inability to blossom as though paralysed.

July 19.—A paper was received from Prof. Cope "On the Tertiary Coal and Fossils of Osino Nevada." The fossils were shown to be *Planorbis* and other freshwater forms; insects (largely *Diptera*) in beautiful preservation, and fishes. The shales resemble the *papier kohle* of Bonn, and contain great numbers of leaves.—Prof. Chase read a paper on "Ætherial Oscillation, the primordial force;" and stated that certain meteorological predictions had been verified, which had been based on his observations of the rainfall at San Francisco.

August 16.—"Descriptions of some new Vertebrata from the Bridger group of the Eocene; second account of new extinct Vertebrata from the Bridger Eocene." In the former, among other new forms, was described *Mesonyx*, a genus of Carnivora or allied form with teeth with only one row of conic tubercles and with flat claws, allied to *Hyaenodon*. Also a genus allied to both Proboscidians and Rodents, without molar teeth, called *Pseudotomus*.—A communication from Prof. Cope was read on his discovery of "*Proboscidia* in the Wyoming Eocene," this order having been previously unrecognised below the Miocene in America. A new genus, *Eobasileus*, was described; dentition, i, 0; c, 1; pm, 3; m, 2, horns on the top of the head. Three species were described, *E. cornutus*, of gigantic size, represented by cranium, scapula, vertebræ, pelvis and femur complete. The horn cores trihedral, the muzzle with two horizontal superior shovel-like expansions. *E. furcatus* with bifurcate nose, with spatulate processes; and *E. pressicornis* with massive feet, flattened horns and high occiput. The tusks were dangerous weapons, a foot long, and sabre-shaped, but the molars were small.

ITALY

R. Accademia dei Lincei, Jan. 5.—Prof. Respighi, in a note upon the solar diameter, proposed to show that the differences of the results in the daily observations of the duration of the meridian passage of the solar disc, ought not to be attributed to real variations in the diameter of the solar disc, caused by the temporary enlargement or diminution of the photosphere, or to variations in brightness arising from the constitution of the photosphere, but rather to the inaccuracies of measurement which inevitably attend such very difficult observations. In observations of the contacts on the solar border by means of the micrometer, there are two principal sources of error, the influence of which may sensibly vary from day to day; they are: (1) The difference of the conditions between the contacts of the west and east limbs. Prof. Respighi observed first by a micrometer in a faintly illuminated field, and secondly in a highly illuminated one: this is apt to introduce an error variable from day to day into the observations of the same person, in proportion to the clearness or transparency of our atmosphere, and will probably become greater when the sky is less clear. (2) From the state of undulation of the solar limb, variable from day to day, there may result a sensible and variable increase of the extent of the disc or diameter of the sun. These influences will not be excluded by the proficiency of the observer, by the use of good instruments, nor by the chronographic registration of the contacts. For the purpose of more thoroughly studying these variations, and investigating their origin, recourse was recently had to the spectroscopic combination of Father Secchi, by which the solar limb or image was obtained, formed by monochromatic or almost monochromatic rays; and from a series of observations made with this apparatus it was found that the solar diameter was less by ·6" than that given in the *Nautical Almanac*. Hence it has been inferred that by depriving the solar disc or diameter of the influence of the chromosphere its extent is diminished by about 8" from that obtained by means of the telescope. And therefore it has been inferred that the variations in the solar diameter very probably depend on the variable increase produced on it by the chromosphere, in relation to the extent and intensity of light and the varying state of transparency of our atmosphere. Prof. Respighi, after having shown how the light of the chromosphere could not make any sensible difference to an image of the solar limb or disc, expounded the results obtained from various observations, made by him on the solar diameter by means of the spectroscopic combination alluded to, both with the objective and direct-vision prisms, applied in front of the slit of the spectroscope, using every precaution to exclude the various sources of error. From these observations it results that the duration of the passage of the solar diameter is essentially the same, taking the contacts at the various spectral lines, B, C, D, E, F, and that the measurement agrees very closely with that of the *Nautical Almanac*. The same result is obtained in determining the duration of the passage of the solar limb by means of the slit of the simple spectroscope. Hence Prof. Respighi concludes that while the difference between the solar diameter, as given by the spectroscope and that given by the telescope alone has not been proved, so the suspected origin of this difference is inadmissible, and therefore also any daily variations in the solar diameter.

VIENNA

I. R. Geological Institute, Jan. 7.—Contributions to a more accurate interpretation of fossil vegetable remains from the salt-stock of Wieliczka (Galicia), by M. Dionys Stur. By dissolving in water pieces of salt from Wieliczka, which included vegetable remains, M. Stur succeeded in getting the latter in a state of preservation and purity which permitted an accurate examination; his very interesting inquiries rectify in many points the determinations made by one of the first authorities in fossil botany, Prof. Unger, who many years ago had given a description of these remains in the first volume of the memoirs of the Vienna Academy. To the most frequent of them belong pine-nuts; besides the one species, *Pinus salinarum* Partsh, described by Unger, Stur discovered two other species: *P. polonica*, which is allied to the existing *P. Massoniana* Lamb, and the larger, *P. Russeggeri*, resembling the *P. rigida* Mill. A very curious fact is noted in connection with these cones; while many of them are perfectly well preserved, many others were found with scales gnawed or bitten off, exactly in the same manner as squirrels (*Sciurus*) demolish the pine-nuts of our forests in order to get their seed corns. Pine-nuts which were not quite ripe are bitten on one side (the sun-side) only, while perfectly ripe nuts are demolished to the basis, which then shows a deceptive likeness with the cupula of an acorn. Indeed the two vegetable remains described by Unger as the cupulæ of *Quercus Saturni* and *Q. limnophila* are but pine-nuts destroyed in the same manner: moreover the oak-apples themselves, mentioned by Unger, have proved to belong to quite different plants. The so-called nut of *Q. glans Saturni* Unger, is the nut of *Carya costata* Sternb, which is also gnawed by a squirrel, whilst the nut taken by Unger for the fruit of *Q. limnophila*, is the fruit of a palm very similar to that of the existing *Raphia tacdigera*, and is named by Stur *Raphia Ungeri*.—K. v. Hauer gave a description of the large quarries in the tertiary limestone of Zogelsdorf in Austria, ; in former years they had furnished almost all building stones for Vienna, especially for the famous tower of St. Stephen. Upon the discovery of a very good building stone nearer to the town in the Leitha mountains the quarries of Zogelsdorf decayed, but as soon as the Franz-Joseph railway, which passes very near the spot, made cheap transport practicable, they were reopened by the present possessor, Baron Suttner, and are worked now very extensively.—Dr. G. Stache described an earthquake which was felt in Vienna on January 3, some minutes before 7 o'clock in the evening. In some parts of the town, for instance in the working rooms of the Geological Institute, in the palace of Prince Liechtenstein two shocks were observed, the second tolerably vehement, with a rolling noise. The direction seemed N.W. to S.E.; the duration of the phenomenon was about four seconds.

DIARY

THURSDAY, FEBRUARY 27.

ROYAL SOCIETY, at 8.30.—On Leaf Arrangement: Dr. Hubert Airy.

SOCIETY OF ANTIQUARIES, at 8.30.—Northamptonshire Star-Chamber Proceedings, Temp. James I.: W. H. Hart.

ROYAL INSTITUTION, at 3.—On the Artificial Formation of Organic Substances: Prof. Rutherford.

FRIDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 9.—On Livingstone's Explorations in Africa: Sir H. C. Rawlinson.

QUEKETT CLUB, at 8.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

SATURDAY, MARCH 1.

ROYAL INSTITUTION, at 3.—On the Philosophy of the Pure Sciences: Prof. W. K. Clifford.

MONDAY, MARCH 3.

ENTOMOLOGICAL SOCIETY, at 7.

LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

ROYAL INSTITUTION, at 2.—General Monthly Meeting.

CANTOR LECTURES, at 8.—On the Energy of Electricity: Arthur Rigg.

TUESDAY, MARCH 4.

ANTHROPOLOGICAL SOCIETY, at 8.—On the Looshais: Dr. A. Campbell.—Implements and Pottery from Canada: Sir Duncan Gibb, Bart., M.D.—The Ventnor Flints: Hodder M. Westropp.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.

ZOOLOGICAL SOCIETY, at 8.30.—On the Spiders of St. Helena: Rev. O. P. Cambridge.—On some Marine Mollusca from Madeira: R. B. Watson.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, MARCH 5.

SOCIETY OF ARTS, at 8.—On Gas-lighting by Electricity, and Means for Lighting and Extinguishing Street and other Lamps: W. Lloyd Wise.

MICROSCOPICAL SOCIETY, at 8.—Notes on the Micro-Spectroscope and Microscope: E. J. Gayer.

LONDON INSTITUTION, at 7.—Musical Lecture.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

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THURSDAY, MARCH 6, 1873

HARVESTING ANTS AND TRAP-DOOR SPIDERS

Harvesting Ants and Trap-Door Spiders. Notes and Observations on their Habits and Dwellings. By J. Traherne Moggridge, F.L.S. (L. Reeve and Co., 1873.)

THIS beautifully illustrated little book is a good example of what can be done by a careful observer in a very short time. It might have been thought that the habits of European insects were pretty well known, and that a person comparatively new to the subject could not hope to add much to our knowledge. But the fact is quite otherwise, for Mr. Moggridge, in the course of a few winters spent in the south of Europe has, by careful observation, thrown considerable light on the habits and economy of two important groups of insects, and, as regards one of them, has disproved the dogmatic assertions of several eminent entomologists. Nothing is more curious than the pertinacity with which scientific men will often draw general conclusions from their own special observations, and then use these conclusions to set aside the observations of other men. Mr. Moggridge now confirms, in many of their minutest details, the accounts given by classical writers of the habits of ants. These habits were recorded with so much appearance of minute observation, that they bear the impress of accuracy; yet because the Ants of England and of Central Europe have different habits, it was concluded that the old authors invented all these details, and that they were at once accepted as truths and became embodied in the familiar sayings of the time. The ants were described as ascending the stalks of cereals and gnawing off the grains, while others below detached the seed from the chaff and carried it home; as gnawing off the radicle to prevent germination, and spreading their stores in the sun to dry after wet weather. Latreille, Huber, Kirby, Blanchard, and many less eminent authors, treat these statements with contempt, and give reasons why they cannot be true for European species, yet we here find them verified in every detail by observations at Mentone and other places on the shores of the Mediterranean. Mr. Moggridge has, however, supplemented these observations by discovering the granaries in which they are stored (sometimes excavated in solid rock), of which accurate plans are given. He has seen them in the act of collecting seeds, and has traced seeds to the granaries, from which all husks and refuse are carefully carried away; he has seen them bring out the grains to dry after rain, and nibble off the radicle from those which were germinating; lastly, he has seen them (in confinement) feed on the seeds so collected. A very curious point is, that the collections of seeds, although stored in very damp situations, very rarely germinate; yet nothing has been done to deprive them of vitality, for on being sown they grow vigorously. The species of harvesting ants observed were, *Pheidole megacephala*, *Atta structor*, *A. barbara*, and a larger and differently coloured variety of the last. *Atta structor* is found over a large part of Central Europe, yet, as it has never been observed to lay up stores of seeds in more northern countries, it either has different habits according to locality, or local observers have strangely overlooked its peculiarities. The seeds of more than thirty species of plants were found stored up, none of which were cereals; but at Hyères, M. Germain St. Pierre has observed these latter stored by ants in such quantities that he thinks their depredations must cause serious loss to cultivators. Thus we have another important confirmation of the statements of the old writers.

The second part of the book gives a very interesting and elaborate account of the curious nests of the Trap-Door spiders of the south of Europe, of which two new forms are described, one of them being constructed by a hitherto undescribed species of spider. The nests previously known have a hinged door at the upper end of the tubular nest, but Mr. Moggridge found another kind with a second door lower down, and also one with a lateral chamber the opening to which, as well as the main tube, is closed by the second door. In these nests the lower door is strong and fits closely, and can be held fast by the spider on the inside, while the upper door is for concealment only, being very thin, but almost always closely resembling the surrounding surface. In many cases it is overgrown with living moss and lichens, and Mr. Moggridge thinks that the spider plants or sows the mosses, having found little bits of moss stuck on to a newly-made door. A curious and instructive observation occurs as to the simple manner in which a protective adaptation may be brought about unconsciously. Having cut away the top of one of these nests and thus left the tube exposed on a surface of bare earth, the spider made a new door in which it stuck pieces of moss from the neighbouring moss-covered bank, thus making its nest very conspicuous by the round patch of green on a surface of fresh earth. The simple and natural habit of covering the door of the nest with any material that grows or lies around it usually leads to concealment, but the above example shows that in doing so the insect does not consciously work with this object. Even more curious is the fact that little spiders only a few days old construct nests exactly like those of the parent—tubes excavated in the earth, lined with silk and provided with one or two doors and lateral passages, as the case may be, but only about one-sixth the size. Good reasons are given for believing that these small nests are not abandoned, but enlarged from time to time as the occupant grows bigger. Whether the very young spiders build their nests independently of all teaching or experience is a curious point of inquiry to which our author adverts, and as he suggests that it might not be very difficult to rear young spiders from the egg and place them in conditions favourable for their existence, it is to be hoped that he will try the experiment and help to throw light on a subject on which we have so little positive knowledge.

The numerous coloured plates, giving full-sized representations of the spiders and their habitations, are very carefully drawn, and add greatly to the interest of one of the most original and entertaining books on natural history we have met with for some.

ALFRED R. WALLACE

SEPULCHRAL MONUMENTS OF CORNWALL

Nænia Cornubiæ. A descriptive essay, illustrative of the Sepulchres and Funereal Customs of the early Inhabitants of Cornwall. By W. Copeland Borlase, B.A., F.S.A. (London: Longmans; Truro: Netherton, 1872.)

MEETING with a recent work on any branch of the antiquities of Cornwall, by an author bearing the name of Borlase, is so much like falling in with the ancient landmarks, after having long failed to detect them, as to be in itself a source of pleasure; and this is enhanced on learning that the author of the work before us is not only a namesake, but a great-grandson of Dr. Borlase, the author of "Observations on the Antiquities, Historical and Monumental, of the County of Cornwall," published at Oxford in 1753.

Whilst we have read the book with much pleasure, we have now and then had to regret a lack of distinct method, a tendency to digress, and a tone somewhat too judicial when dealing with questions on which the author differs from older and more experienced antiquaries. As we learn from the Dedication that the author is young, we have little or no doubt that such blemishes will be less conspicuous in the "second series" he contemplates, and which we hope to see at no distant period.

He declines to accept "the hypothetical distinctions drawn between stone, bronze, and iron periods," on account of a few facts he has met with, but which do not appear to contain any danger to the distinctions in question. He lays down the excellent law that the antiquary "should never be ready to sacrifice a fact merely because it is hard to explain, upon the altar of a much more indefensible theory," and soon after reminds us of the well-known maxim—"Do as I say, not as I do;" for when mentioning two instances of graves in each of which, he says, "the monument has consisted of two pillars of unhewn granite, placed at no great distance apart," he adds that "Graves adorned in this manner are the common property of all ages and all religions," and then slides into an attempt to make Homer support the converse proposition—that such pillars are to be always regarded as indications of a grave. For this purpose he quotes the *Iliad*, xxxiii. 329, and gives the following as Mr. Wright's translation:—

> "On either side
> Rise two white stones, set there
> To mark the tomb of some one long since dead."

We are afraid that Mr. Borlase has here been willing to sacrifice a *fact* rather than his *theory*. The passage in Homer and its bearing on the question had been previously mentioned by Sir John Lubbock,[*] who also uses Wright's translation. At the burial of Patroclus, Nestor, pointing out to his son the course for the chariot race, says:—

> "Plain is the goal
> That now I tell thee of; nor canst thou miss it—
> Upraised four cubits high above the ground
> There stands a wizen stump, of oak or pine,
> Not rotted by the rain. On either side—
> Where narrowest is the way, and all the course
> Around is smooth—rise two white stones, set there
> To mark the tomb of some one long since dead,
> Or form the goal for men in ages past,
> But now the goal of Peleus' god-like son."

It is obvious, from the last line but one, that Homer was by no means certain that such stones invariably marked a grave.

Having pointed out the few defects of the book which struck us, we now proceed to the more agreeable duty of giving a brief summary of its contents.

Mr. Borlase rejects unconditionally the hypothesis that the megalithic remains in Cornwall are druidical. To Sir J. Lubbock's remark that "A complete burial place may be described as a dolmen, covered by a tumulus, and surrounded by a stone circle; often, however, we have only the tumulus, sometimes only the dolmen, and sometimes only the circle," he proposes to add, "sometimes only two adjacent menhirs, and sometimes only the single standing stone," and states that "under the one or the other head may be classed every mode of interment hitherto discovered in Cornwall."

He divides European Cromlechs into three classes: 1. The Dolmen, or "table-stone" proper, where the vertical supports do not *enclose* a space, or form a continuous wall. 2. The Larger Kist-Vaen, or stone chest, where the vertical supports and the covering stone form an enclosed chamber, designed to hold the body, and covered, sometimes very slightly, with a mound. 3. Monuments similar in structure to the Kist-Vaen just described; but instead of receiving the body are merely cenotaphs raised over the actual grave. There is in Cornwall no instance of the third class.

The first, or dolmen, is much higher than the others, and is comparatively rare, there being but two examples in the county. Lanyon Cromlech, in the parish of Madron, near Penzance, consists entirely of granite, and was described by Dr. Borlase. It fell in 1815, and was set up again in 1824, but some of the stones had been broken. The covering stone, or quoit as it is termed in Cornwall, measured 47 ft. in circumference, and averaged 20 in. in thickness. It was supported by three thin unhewn pillars, at a height sufficient to permit a man on horseback to sit under it. Caerwynen Cromlech, near Camborne, resembles that just described in construction and material. The quoit measures 12·75 ft., and its three supporters varied from 5·17 ft. to 4·9 ft. high. This monument has also fallen and been replaced. A simple, but unoccupied, grave cut in the soil was found under the quoit at Lanyon, but it does not appear that any search has been made at Caerwynen.

Of the second class of cromlechs, or larger kist-vaens, Mr. Borlase describes no fewer than eight examples—five near the western extremity, two near the centre of the northern coast, and one in the south-east of the county; but no more than one in each division is now perfect or approximately so. They all consist of the rock of the district or its vicinity, and six of them are of granite, whilst two are of a "sparry rock." One is in a valley, but at least five occupy conspicuous positions on high ground. There are distinct indications that several of them were covered with a barrow of earth or stones, and one, Lower Lanyon Cromlech, was so covered when it was found. The author claims for the Chywoone or Chûn Cromlech, in the parish of Morvah, near Penzance, the distinction of being the most perfect and compact now in the county, and ventures on the following speculation respecting the process of its erection:—The east and west ends, each 6·3 ft. high and 3·9 ft. and 4 ft. broad respectively, were first set up 6 ft. apart. Against their western edges a flat block of granite, 8·3 ft. long, was placed in a slanting position. On this northern side, probably over this sloping stone, with the assistance of an embankment and rollers, a rough slab of hard-grained granite, convex on one side, 12 ft. in length and breadth, and from 14 in. to 2 ft. in thickness, was raised as the covering-stone

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[*] "Prehistoric Times," 2nd edition, 1869, pp. 109, 110.

Finally a stone 7·67 ft. long, but not high enough to reach the covering stone, was placed on the south side. The chamber is 7 ft. high within, and a small pit seems to have been sunk in the natural soil at the centre. The pile is surrounded, and was probably covered, with a barrow, which still in some places nearly reaches the top of the side stones. It measures 32 ft. in diameter and is surrounded with upright stones. The interstices between the sides of the chamber were filled with small stones, calculated to prevent the entrance of any rubbish.

The Pawton Cromlech, in the parish of St. Breock, near Wadebridge, occupies high ground, and is intact. The kist, 7·5 ft. long, 2 ft. wide at one end and 3·5 ft. at the other, and at least 5 ft. deep, is formed with eight sparry side-stones, more than half buried in an oval tumulus, 60 ft. long. The quoit, also a sparry stone, supported by only three of the side-stones, is 7 ft. broad, 2·5 ft. thick, and, though a portion of it has been broken off, still 13 ft. long.

Trethevy, or Trevethy, Cromlech, or "Stone," in the parish of St. Cleer, near Liskeard, in south-east Cornwall, is stated by the author to be the largest, though perhaps the least known of the Cornish cromlechs. Nevertheless, he adds that it was described by Norden about 1610, and has been the subject of two papers in the present century. It consists of six upright stones, only three of which support a quoit, 13 ft. long, 9 broad, and 1 thick, which, on account of the unequal heights of its supporters, is 13 ft. above the ground at one point, and not more than 7·5 feet at another. The eastern or principal and highest supporter, rising nearly 10 ft. above the small mound on which the whole stands, has almost the appearance of a wrought stone. A ruder stone, almost equally high, rests against it like a buttress. The two stones on each side of the chamber are several feet shorter. The western end is open, but an eighth stone, considerably longer than the side-stones, lying lengthways along the kist, as if it had fallen there, was probably the supporter of that extremity. The interior of the chamber is from 9 to 10 ft. long, and from 5·5 to 6·5 ft. broad. There is near the bottom of the eastern supporter an aperture 2 ft. high, and 1·75 broad, and in the north-east corner of the quoit, where it extends beyond the kist, a hole not quite circular, from 6 to 8 in. across. Norden speaks of the latter as "an arteficiall holl, which served as it seemeth to put out a staffe, whereof the house itself was not capable." Mr. Pattison, a careful student of the geology and antiquities of Cornwall, also states that "the sides are smooth, as if worn by a staff;" and Mr. Borlase is of opinion that "such is, without doubt, the account of it." If this be so, it apparently indicates that the cromlech, whatever its origin, had not been restricted to funeral uses. The author calls attention to the fact that a hole is frequently found in the dolmens of Eastern Europe and India, adding, however, that this always occurs in one of the sides and communicates with the interior of the chamber, whilst in the Cornish example it passes through an overlapping portion of the quoit. Without expressing an opinion on this question, we would remind those who have "done" Dartmoor that they have probably been taken by the guide to see, lying in some of the streams, blocks of granite having approximately circular smooth holes passing completely through them, and, though there could be no doubt that they were due to the action of running or falling water, have been expected to regard them as somewhat mysterious. Is it not possible that, when choosing their slabs, one which happened to be thus naturally perforated, if suitable in all other respects, would be selected rather than rejected by the cromlech builders? Trethevy Cromlech consists of granite, and Mr. Pattison, quoted by Mr. Borlase, has called attention to the fact that this rock, where nearest the cromlech, occurs as boulders about half a mile distant across a broad upland valley, and adds that "the builders must therefore have credit for the exertion of combined strength and skill in transporting these enormous masses of rock across the hollow and up the hill on which they stand." Though, if necessary, we are quite prepared to concur in this, it must not be forgotten that the agency which lodged boulders on one side of the valley, may perhaps have deposited a few on the other, so that the builders may have found their materials nearer home.

Zennor Cromlech, in the parish of the same name, near St. Ives, now dismantled, was in the time of Dr. Borlase the most interesting and perfect kist-vaen in West Cornwall, and remarkable on account of the extension of the side-stones beyond the eastern end of the chamber, where with the aid of two additional stones, they formed a little cell. Such an addition appears to be unique in Cornwall, but in Wales and Anglesea it seems to be the rule rather than the exception for a small kist-vaen to exist side by side with the large one.

Though there are no *Passage graves* in Cornwall in the sense in which the term is used by Swedish antiquaries, there are several instances of long chambers buried in tumuli, and roofed with large flat stones, and, as in Denmark, termed "Giant's Graves." In 1756 Dr. Borlase described the largest of a group in the island of St. Mary, in Scilly, as 4·5 ft. wide at the mouth, 13·6 ft. long, and 3·6 ft. high, covered from end to end with large flat stones, and having a tumulus of rubbish on top of all.

The largest of a group of three in the parish of Zennor was described and figured in the *Gentleman's Magazine*, July 1865, by Mr. J. T. Blight, who stated that its direction was from N.W. to S.E., and that its dimensions were 9·5 ft. long, 4 ft. wide, and 4·3 ft. high. The roofing slabs, like those in St. Mary's, were of granite; the first, being 6 in. lower than the others, appeared to be designed as a lintel, and made the clear height beneath it no more than 3·5 ft.. The walls were of neat masonry, similar to the hedging work still in use in the neighbourhood; and the whole was covered with a tumulus 70 ft. in circumference, 8 ft. high, and built round at its base with large stones.

Near the village of Castle Euny, in the parish of Sancreed, near Penzance, Mr. Borlase discovered a chambered tumulus in April 1863, in a valley long known to be rich in ancient remains. The tumulus is conical, 8 ft. high and 50 ft. in circumference, and supported at the base with large granite stones, one rising 4 ft. above the ground. The Chamber is 6 ft. long, 3 ft. broad at the entrance and 3·75 at the opposite or northern end, and 3·5 ft. high. Each side and end consists of a single block of granite resting on an artificial elevation 2 ft. high, and the roof is formed of two stones. Though probably

[illegible]

The eastern branch was fainter than the western, and at midnight it was seen from γ Virginis, near the horizon, up to Præsepe in the zenith, as a broad and tapering cone of light.

Hence the zodiacal light, when seen in perfection, consists of two cones of light, whose common axis is the Ecliptic, and whose common vertex is a point on that axis almost exactly 180° from the sun. The fact that the western branch is brighter than the eastern also confirms my idea of its origin, the brighter branch being over the warmer portion of the earth's surface; but I hope to make more observations of its breadth at different times of the year before writing more on this subject.

Jamaica, Feb. 6 MAXWELL HALL

[We hope our correspondent will continue to send us more of his interesting and valuable letters. It is indeed a great gain to science to have an observer stationed on the vantage ground which he occupies.—ED.]

As no one has replied to Maxwell Hall's letter on the zodiacal light (vol. vii. p. 203), I might state that his theory that the earth has two tails which stretch to an indefinite distance away from the sun is not in accordance with observation, for I have often seen the zodiacal light 180° off the sun. This is no proof against M. H.'s other idea that the two tails curve round and meet; but is there anything in M. H.'s observations contrary to the generally received theory of the zodiacal light? This is that it is not a ring, but a somewhat lens-shaped disc of light, brightest and thickest at its centre (at the sun), and gradually growing thinner and less dense, till it seems to vanish some distance beyond the earth's orbit. Its thickness at its centre would therefore be 60,000,000 miles, or more, according to M. H.'s observation. The circumstance that he could not see it more than 177° off the sun might very likely be accounted for by the milky way obscuring it there. T. W. BACKHOUSE

West Hendon House, Sunderland, Feb. 10

The Meteoric Shower

THE shower of meteors on the night of Nov. 27 last year was evidently well seen in Europe, as I had anticipated, but no notice seems to have been taken of the shower on the night of the 24th. On that night there was an equally fine display in Jamaica, from about the same radiant point; the night of the 25th was cloudy, and only a few meteors were seen on the night of the 26th, which was clear; and the shower on the 27th was simply a repetition of the shower on the 24th; but on both occasions the numbers seen here were somewhat less than in Europe.

These meteors must therefore form two almost distinct bands passing round the sun, which their association with the comet of Biela renders particularly interesting; it is just possible that these two bands intersect, and that one part of the comet belongs to one band and the other part to the other, and that they came into notice and actual contact about the same time in the year 1846, and of course afterwards separated.

Jamaica, Jan. 5 MAXWELL HALL

Maupertius on the Survival of the Fittest

CONSIDERING that the theories of Darwin and Spencer are among the most important additions ever made to human knowledge, it seems to be a matter of much interest to trace out any occasional glimpses which previous philosophers may have had of the Principles of Natural Selection. In a long note appended by Lord Bolingbroke to his fourth essay concerning Authority in matters of Religion (octavo edition of the Philosophical Works, 1754, vol. ii. p. 253; quarto edition, 1754, vol. iv. p. 255), he reviews a Memoir by Maupertius printed in the History of the Royal Academy of Berlin, for the year 1746. Speaking of the appearances of design, Lord Bolingbroke says:—"Mr. Maupertius proceeds, and admits, but admits, as it were, for argument's sake alone, that the proportion of the different parts and organs of animals to their wants carries a more solid appearance; and he judges that they reason very ill who assert that the uses to which these parts and organs are applied, were not the final causes of them, but that they are so applied because the animal is so made. Chance gave eyes and ears; and since we have them we make use of them to see and hear. He thinks, however, it may be said, that chance having produced an immense number of individuals, those of them whose parts and organs were proportioned to their wants, have subsisted, whilst those who wanted this proportion have perished and disappeared. Those who had no mouth, for instance, could not eat and live; those who wanted the organs of generation could not perpetuate their species; and thus from the present state of things theists draw an argument which will appear fallacious when it is applied to the possible original of things."

I am not aware that notice has been drawn to this distinct allusion to the survival of the fittest. So far as regards the introduction of the notion of *chance* the statement is no doubt erroneous. W. STANLEY JEVONS

Manchester, Feb. 12

"Diathermanous" or "Transfervent"

THE words "transfervent" and "transferveny" are similar in form to "transparent" and "transparency," and clearly convey their meaning to those who cannot trace them to their source. In number of syllables, also, and in sound are they not more English, or as a Greek might say, less barbarian than words of five, six, or seven syllables which are coined directly from the Greek, but which do not suit so well the Saxon tongue?

W. G. ADAMS

Flight of Projectiles—A Query

I SHALL feel thankful to any of your numerous mathematical correspondents who will kindly favour me with a simple formula for determining the deflection in the flight of a leaden cylindro-conoidal projectile—the time of flight of which is known—caused by wind of known force acting at different angles to the vertical plane of the trajectory, with an application of the formula to the following cases. Any other cause of deviation, such as that due to rotation, &c., may be neglected:—

Suppose the bullet to be 1·27″ long, and its diameter ·447″, weight 480 grs. and the wind to be of force 4, approximate pressure 4 lbs. per square inch, what is the deviation?

1. When the wind acts at right angles to the trajectory?
2. When it acts at any angle less than a right angle, say 45°?

ROBERT REID

School of Musketry, Hythe, Feb. 10

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*ON ACTION AT A DISTANCE**

WE have now arrived at the great discovery by Örsted of the connection between electricity and magnetism Örsted found that an electric current acts on a magnetic pole, but that it neither attracts it nor repels it, but causes it to move round the current. He expressed this by saying that "the electric conflict acts in a revolving manner."

The most obvious deduction from this new fact was that the action of the current on the magnet is not a push-and-pull force, but a rotatory force, and accordingly many minds were set a-speculating on vortices and streams of æther whirling round the current.

But Ampère, by a combination of mathematical skill with experimental ingenuity, first proved that two electric currents act on one another, and then analysed this action into the resultant of a system of push-and-pull forces between the elementary parts of these currents.

The formula of Ampère, however, is of extreme complexity, as compared with Newton's law of gravitation, and many attempts have been made to resolve it into something of greater apparent simplicity.

I have no wish to lead you into a discussion of any of these attempts to improve a mathematical formula. Let us turn to the independent method of investigation employed by Faraday in those researches in electricity and magnetism which have made this institution one of the most venerable shrines of science.

No man ever more conscientiously and systematically laboured to improve all his powers of mind than did Faraday from the very beginning of his scientific career.

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* Continued from p. 325.

But whereas the general course of scientific method then consisted in the application of the ideas of mathematics and astronomy to each new investigation in turn, Faraday seems to have had no opportunity of acquiring a technical knowledge of mathematics, and his knowledge of astronomy was mainly derived from books.

Hence, though he had a profound respect for the great discovery of Newton, he regarded the attraction of gravitation as a sort of sacred mystery, which, as he was not an astronomer, he had no right to gainsay or to doubt, his duty being to believe it in the exact form in which it was delivered to him. Such a dead faith was not likely to lead him to explain new phenomena by means of direct attractions.

Besides this, the treatises of Poisson and Ampère are of so technical a form, that to derive any assistance from them the student must have been thoroughly trained in mathematics, and it is very doubtful if such a training can be begun with advantage in mature years.

Thus Faraday, with his penetrating intellect, his devotion to science, and his opportunities for experiment, was debarred from following the course of thought which had led to the achievements of the French philosophers, and was obliged to explain the phenomena to himself by means of a symbolism which he could understand, instead of adopting what had hitherto been the only tongue of the learned.

This new symbolism consisted of those lines of force extending themselves in every direction from electrified and magnetic bodies, which Faraday in his mind's eye saw as distinctly as the solid bodies from which they emanated.

The idea of lines of force and their exhibition by means of iron filings was nothing new. They had been observed repeatedly and investigated mathematically as an interesting curiosity of science. But let us hear Faraday himself, as he introduces to his reader the method which in his hands became so powerful.*

"It would be a voluntary and unnecessary abandonment of most valuable aid if an experimentalist, who chooses to consider magnetic power as represented by lines of magnetic force, were to deny himself the use of iron filings. By their employment he may make many conditions of the power, even in complicated cases, visible to the eye at once, may trace the varying direction of the lines of force and determine the relative polarity, may observe in which direction the power is increasing or diminishing, and in complex systems may determine the neutral points, or places where there is neither polarity nor power, even when they occur in the midst of powerful magnets. By their use probable results may be seen at once and many a valuable suggestion gained for future leading experiments."

Experiment on Lines of Force

In this experiment each filing becomes a little magnet. The poles of opposite names belonging to different filings attract each other and stick together, and more filings attach themselves to the exposed poles, that is, to the ends of the row of filings. In this way the filings, instead of forming a confused system of dots over the paper, draw together, filing to filing, till long fibres of filings are formed, which indicate by their direction the lines of force in every part of the field.

The mathematicians saw in this experiment nothing but a method of exhibiting at one view the direction in different places of the resultant of two forces, one directed to each pole of the magnet; a somewhat complicated result of the simple law of force.

But Faraday, by a series of steps as remarkable for their geometrical definiteness as for their speculative ingenuity, imparted to his conception of these lines of force a clearness and precision far in advance of that with which the mathematicians could then invest their own formulæ.

In the first place Faraday's lines of force are not to be considered merely as individuals, but as forming a system, drawn in space in a definite manner, so that the number of the lines which pass through an area, say of one square inch, indicates the intensity of the force acting through that area. Thus the lines of force become definite in number. The strength of a magnetic pole is measured by the number of lines which proceed from it; the electrotonic state of a circuit is measured by the number of lines which pass through it.

In the second place each individual line has a continuous existence in space and time. When a piece of steel becomes a magnet, or when an electric current begins to flow, the lines of force do not start into existence each in its own place, but as the strength increases new lines are developed within the magnet or current, and gradually grow outwards, so that the whole system expands from within, like Newton's rings in our former experiment. Thus every line of force preserves its identity during the whole course of its existence, though its shape and size may be altered to any extent.

I have no time to describe the methods by which every question relating to the forces acting on magnets or on currents, or to the induction of currents in conducting circuits, may be solved by the consideration of Faraday's lines of force. In this place they can never be forgotten. By means of this new symbolism, Faraday laid down with mathematical precision the whole theory of electro-magnetism, in language free from mathematical technicalities, and applicable to the most complicated as well as the simplest cases. But Faraday did not stop here. He went on from the conception of geometrical lines of force to that of physical lines of force. He observed that the motion which the magnetic or electric force tends to produce is invariably such as to shorten the lines of force and to allow them to spread out laterally from each other. He thus perceived in the medium a state of stress, consisting of a tension like that of a rope, in the direction of the lines of force, combined with a pressure in directions at right angles to them.

This is quite a new conception of action at a distance, reducing it to a phenomenon of the same kind as that action at a distance which is exerted by means of the tension of ropes and the pressure of rods. When the muscles of our bodies are excited by that stimulus which we are able in some unknown way to apply to them, the fibres tend to shorten themselves and at the same time to expand laterally. A state of stress is produced in the muscle, and the limb moves. This explanation of muscular action is by no means complete. It gives no account of the cause of the excitement of the state of stress, nor does it even investigate those forces of cohesion which enable the muscles to support this stress. Nevertheless, the simple fact, that it substitutes a kind of action which extends continuously along a material substance for one of which we know only a cause and an effect at a distance from each other, induces us to accept it as a real addition to our knowledge of animal mechanics.

For similar reasons we regard Faraday's conception of a state of stress in the electro-magnetic field as a possible method of explaining action at a distance by means of the continuous transmission of force, even though we do not know how the state of stress is produced.

But one of Faraday's most pregnant discoveries, that of the magnetic rotation of polarised light, enables us to proceed a step further. It has been pointed out by Sir W. Thomson that the phenomenon, when analysed into its simplest elements, can be expressed thus: that of two circularly polarised rays of light, precisely similar in configuration, but rotating in opposite directions, that ray is propagated with the greater velocity which rotates in the same direction as the electricity of the magnetising current.

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* Exp. Res. 3284.

It follows from this, by strict dynamical reasoning, that the medium under the action of magnetic force must be in a state of rotation—that is to say, that small portions of the medium, which we may call molecular vortices, are rotating, each on its own axis, the direction of this axis being that of the magnetic force.

Here, then, we have an explanation of the tendency of the lines of magnetic force to spread out laterally and to shorten themselves. It arises from the centrifugal force of the molecular vortices. The mode in which electromotive force acts in starting and stopping the vortices is more abstruse, though it is of course consistent with dynamical principles.

We have thus found that there are several different kinds of work to be done by the electro-magnetic medium if it exists. We have also seen that magnetism has an intimate relation to light, and we know that there is a theory of light which supposes it to consist of the vibrations of a medium. How is this luminiferous medium related to our electro-magnetic medium?

It fortunately happens that electro-magnetic measurements have been made from which we can calculate by dynamical principles the velocity of propagation of small magnetic disturbances in the supposed electro-magnetic medium.

This velocity is very great, from 288 to 314 millions of metres per second, according to different experiments. Now the velocity of light, according to Foucault's experiments, is 298 millions of metres per second. In fact, the different determinations of either velocity differ from each other more than the estimated velocity of light does from the estimated velocity of propagation of small electro-magnetic disturbance. But if the luminiferous and the electro-magnetic media occupy the same place, and transmit disturbances with the same velocity, what reason have we to distinguish the one from the other? By considering them as the same, we avoid at least the reproach of filling space twice over with different kinds of æther.

Besides this, the only kind of electro-magnetic disturbance which can be propagated through a non-conducting medium is a disturbance transverse to the direction of propagation, agreeing in this respect with what we know of that disturbance which we call light. Hence, for all we know, light also may be an electro-magnetic disturbance in a non-conducting medium. If we admit this, the electro-magnetic theory of light will agree in every respect with the undulatory theory, and the work of Thomas Young and Fresnel will be established on a firmer basis than ever, when joined with that of Cavendish and Coulomb by the keystone of the combined sciences of light and electricity—Faraday's great discovery of the electro-magnetic rotation of light.

The vast interplanetary and interstellar regions will no longer be regarded as waste places in the universe, which the Creator has not seen fit to fill with the symbols of the manifold order of His kingdom. We shall find them to be already full of this wonderful medium; so full, that no human power can remove it from the smallest portion of space, or produce the slightest flaw in its infinite continuity. It extends unbroken from star to star, and when a molecule of hydrogen vibrates in the dogstar, the medium receives the impulses of these vibrations; and after carrying them in its immense bosom for three years, delivers them in due course, regular order, and full tale into the spectroscope of Mr. Huggins, at Tulse Hill.

But the medium has other functions and operations besides bearing light from man to man, and from world to world, and giving evidence of the absolute unity of the metric system of the universe. Its minute parts may have rotatory as well as vibratory motions, and the axes of rotation form those lines of magnetic force which extend in unbroken continuity into regions which no eye has seen, and which by their action on our magnets, are telling us in language not yet interpreted what is going on in the hidden under-world from minute to minute and from century to century.

And these lines must not be regarded as mere mathematical abstractions. They are the directions in which the medium is exerting a tension like that of a rope, or rather like that of our own muscles. The tension of the medium in the direction of the earth's magnetic force is in this country one grain weight on eight square feet. In some of Dr. Joule's experiments, the medium has exerted a tension of 200 lbs. weight per square inch.

But the medium, in virtue of the very same elasticity by which it is able to transmit the undulations of light, is also able to act as a spring. When properly wound up, it exerts a tension, different from the magnetic tension, by which it draws oppositely electrified bodies together, produces effects through the length of telegraph wires, and when of sufficient intensity, leads to the rupture and explosion called lightning.

These are some of the already discovered properties of that which has often been called vacuum, or nothing at all. They enable us to resolve several kinds of action at a distance into actions between contiguous parts of a continuous substance. Whether this resolution is of the nature of explication or complication, I must leave to the metaphysicians.

ON LEAF-ARRANGEMENT[*]

ASSUMING, as generally known, the main facts of Leaf-arrangement—the division into the whorled and spiral types, and in the latter more especially the establishment of the convergent series of fractions, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, $\frac{21}{55}$, $\frac{34}{89}$, $\frac{55}{144}$, &c., as representatives of a corresponding series of spiral leaf-orders among plants—we have to ask what is the meaning that lies hidden in this law?

Mr. Darwin has taught us to regard the different species of plants as descended from some common ancestor; and therefore we must suppose that the different leaf-orders now existing have been derived by different degrees of modification from some common ancestral leaf-order.

One spiral order may be made to pass into another by a twist of the axis that carries the leaves. This fact indicates the way in which all the spiral orders may have been derived from one original order, namely, by means of different degrees of twist in the axis.

We naturally look to the simplest of existing leaf-orders, the two ranked alternate order $\frac{1}{2}$, as standing nearest to the original; for it is manifest that the orders at the other extreme of the series, the condensed arrangement of scales on fir-cones, of florets in heads of *Compositæ*, of leaves in close-lying plantains, &c., are special and highly developed instances, to meet special needs of protection and congregation: they are, without doubt, the latest feat of phyllotactic development; and we may be sure that the course of change has been from the simple to the complex, not the reverse. This point will be illustrated by experiment below.

But first, what are the uses of these orders?—and at what period of the leaf's life does the advantage of leaf-order operate? The period must be that at which the leaf-order is most perfect; not therefore when the twig is mature, with long internodes between the leaves; but while the twig and its leaves are yet *in the bud*; for it is in the bud (and similar crowded forms) that the leaf-order is in perfection, undisturbed by contortions or inequalities of growth; but, as the bud develops into the twig, the leaves become separated, the stem often gets a twist, the leaf-stalks are curved and wrung to present the blades favourably to the light, and thus the leaf-order that was perfect in the bud is disguised in the grown twig.

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[*] Abstract of paper read by Mr. Hubert Airy, M.A., M.D., before the Royal Society, February 27, 1873.

In lateral shoots of yew and box and silver fir we see how leaves will get their stalks twisted to obtain more favourable exposure to light; and if general distribution round the stem were useful to the adult leaves, we should expect the leaves of a vertical elm-shoot (for example) to secure such distribution by various twists of stalk and stem; but the leaf-blades of the elm keep their two ranks with very great regularity. This goes to show that it is not in the mature twig that the leaf-order is specially advantageous.

In the bud, we see at once what must be the use of leaf-order. It is for the economy of space, whereby the bud is enabled to retire into itself and present the least surface to outward danger and vicissitudes of temperature. The fact that the order $\frac{1}{2}$ does not exhibit this advantage in any marked degree, supports the idea that this order is the original from which all the more complex spiral orders have been derived.

The long duration of the bud-life, as compared with the open-air life of the leaf, gives importance to the conditions of the former. The open-air life of the bud is twelve months, and adding the embryo-life of the bud, we have about a year and a half for the whole life of the bud; and for the twelve months of its open-air life it is in a state of siege, against which a compact arrangement of its embryo-leaves within must be of great value. But the open-air life of the unfolded leaves is (except in evergreens) not more than six months.

That the order $\frac{1}{2}$ would under different degrees of contraction (with twist) assume successively the various spiral orders that exist in nature, in the order of their complexity, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, &c., may be shown by the following experiment:—

Take a number of spheres (say oak-galls) to represent embryo-leaves, and attach them in two rows in alternate order ($\frac{1}{2}$) along opposite sides of a stretched india-rubber band. Give the band a slight twist, to determine the direction of twist in the subsequent contraction, and then relax tension. The two rows of spheres will roll up with a strong twist into a tight complex order, which, if the spheres are attached in close contact with the axis, will be nearly the order $\frac{1}{3}$, with three steep spirals. If the spheres are set a little away from the axis, the order becomes condensed into (nearly) $\frac{2}{5}$, with great precision and stability. And it appears that further contraction, with increased distance of the spheres from the axis, will necessarily produce the orders (nearly) $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, &c., in succession, and that these successive orders represent successive *maxima* of stability in the process of change from the simple to the complex.

It also appears that the necessary sequence of these successive steps of condensation, thus determined by the geometry of the case, does necessarily exclude the non-existent orders $\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{9}$, $\frac{4}{11}$, &c.

Numbering the spheres from 0 upwards, it appears that, under contraction, the following numbers are brought successively into contact with 0, alternately with right and left:—1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, &c. None of them stands vertically above 0 while in contact with it, but a little to the right or a little to the left, and so far the results of this experiment fall short of the perfect fractions $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, &c.; but in this very failure the results of the experiment are more closely in agreement with nature than are those perfect fractions themselves, for those fractions give the angular divergence only in round numbers (so to speak), and lose account of the little more or the little less which makes all the difference between a vertical rank and a spiral. In the large majority of spiral-leaved plants, one has to be content with "$\frac{2}{5}$ nearly" or "$\frac{3}{8}$ nearly," and it is difficult to find a specimen in which the fraction represents the order exactly.

The geometrical relations of the members of the above series 1, 2, 3, 5, 8, 13, &c., are as simple as their numerical relations.

Analysis of the order seen in the head of the sunflower, and other examples, by consideration of their several sets of spirals, presents striking agreement with the above synthetical process. In the sunflower, a marginal seed taken as 0 is found to be in contact with the 34th, the 55th, and the 89th (counted in order of growth), and even with the 144th,, if there is not contact with the 34th. The dandelion, with a lower degree of condensation, has 0 in contact with the 13th, the 21st, and the 34th in large specimens. The house-leek in its leaf-order has 0 in contact with the 5th, 8th, and 13th. The apple-bud has 0 in contact with the 2nd, 3rd, and 5th; and thus we see that in nature the very same series of numbers is found to have contact-relation with 0, which we have already seen possessing that relation in the experimental condensation of the order $\frac{1}{2}$.

Difference of leaf-order in closely-allied species (e.g. *Plantago major* and *P. Coronopus*) is found in close relation to their different habits and needs.

The prevalence of the order $\frac{1}{2}$ in marine *Algæ*, and in *Gramineæ*, a low-developed gregarious group, and its singular freedom from individual variation in that group and in elm, beech, &c., support the view that this order is the original of the spiral orders.

In many plants we find actual transition from the order $\frac{1}{2}$ to an order more complex, as, for instance, Spanish chestnut, laurels, nut, ivy,—and these instances agree in presenting the complex order in the buds that occupy the most exposed situations, while they retain the simple $\frac{1}{2}$ in the less exposed lateral buds. Several kinds of aloe have the order $\frac{1}{2}$ in their basal leaves and a higher order in the remainder. A species of cactus often contains a complete epitome of phyllotaxy in a single plant or even in a single shoot.

Shoots of acacia often present a zigzag disposition of their leaves, on either side of the branch, which seems unintelligible except as a distortion of an original two-ranked order.

The prevalent two-ranked arrangement of rootlets or roots seems to be a survival underground of an order which originally prevailed through the whole plant, root, stem, and branch.

In the whole Monocotyledonous class, the first leaves in the seed have the order $\frac{1}{2}$. In the Dicotyledonous class the first leaves in the seed have the simplest order of the whorled type.

As the spiral orders have probably been derived from a two-ranked alternate arrangement, so the whorled orders have probably been derived from a two-ranked *collateral* (two abreast) arrangement. This is illustrated by an experiment similar to the former, and it is seen that successive parallel horizontal pairs of spheres are compelled under contraction to take position at right angles to one another, exactly in the well-known crucial or decussate order. These whorls of two contain potentially whorls of three and four, as is seen in variations of the same plant, but the experiment does not show the change.

The reason of the non-survival of the (supposed) two-ranked *collateral* order lies in its manifest instability, for under lateral pressure it would assume the alternate, and under vertical the crucial order.

The bud presents in its shape a state of equilibrium between a force of contraction, a force of constriction, and a force of growth.

To sum up, we are led to suppose that the orignal of all existing leaf-orders was a two-ranked arrangement, somewhat irregular, admitting of two regular modifications, the alternate and the collateral; and that the alternate has given rise to all the spiral orders, and the collateral to all the whorled orders, by means of advantageous condensation in the course of ages.

ON THE SPECTROSCOPE AND ITS APPLICATIONS

V.

SPECTRUM analysis, then, teaches us this great fact, that solids and liquids give out continuous spectra, and that vapours and gases give out discontinuous spectra; that is to say, that we get bright lines in different parts of the spectrum, instead of having an unbroken light all over the spectrum. I might vary this statement by stating broadly that the radiation or giving out of light by solids and liquids is a general one, and that the radiation or giving out of light by gases and vapours, instead of being general, is in the main a selective one.

The tubes, to which reference has already been made, put us then in complete possession of a point which has already been arrived at by two different lines of investigation. A few years ago Dr. Frankland, in investigating the spectrum of hydrogen, which, as you know, according to the statement I have just made, ought to give a discontinuous spectrum, discovered that, when observing the spectrum under very great pressure, he got a white light, and a continuous spectrum. Afterwards Dr. Andrews, another fellow of the Royal Society, who was working at the theory of vapours and the theory of liquids from a perfectly different stand-point, and who never thought of using a spectroscope at all, arrived at the conclusion that it was quite possible that vapours might be so condensed in almost every case, that by crushing them together, so to speak, you might really arrive at a liquid form of the vapour which you might choose to investigate. I hope you will not think that these high physical investigations are not practical enough. Let me remind you that we do not know what they may lead to.

Not only did Dr. Frankland determine that very dense gases and very dense vapours gave continuous spectra, but in another research, in which I have had the honour of being associated with him, we have shown that the spectrum of a vapour or of a gas does very much more than tell us merely what the gas or vapour experimented upon is; it in fact tells us something of the physical condition of that gas or vapour, that is to say, whether it is very rare or whether it is very closely packed together—whether it exists under a low or a high pressure. Very fortunately for us, this is an investigation which has not only an immense application in every chemical experiment with which the spectroscope has to do, but it has its story to tell and its aid to give concerning every star that shines in the heavens. We may state generally that, beginning with any one element in its most rarefied condition, and then following its spectrum as the molecules come nearer together, so as at last to reach the solid form, we shall find that spectrum become more complicated as this approach takes place, until at last a vivid continuous spectrum is reached.

Spectrum analysis, then, if it merely differentiated between gases, vapours, solids, and liquids, and between gases and vapours in different states of pressure, would really be a new chemistry altogether; and I have no doubt that the time is not very far distant when, not only in the chemist's laboratory, but in a great many applications of the physical sciences, the spectroscope will be considered as necessary, and will be almost as much used, as a chemical balance, and the sooner that time comes the better.

But not only are we able to differentiate between different bodies, but the most minute quantities of substances can be determined by this method of research. The thing seems so impossible, that you may, some of you, feel inclined to doubt my assertion when I tell you, for instance, that Kirchhoff and Bunsen have calculated that the 18-millionth part of a grain can be determined by the spectroscope in the case of sodium; that is to say, if in anything which I choose to examine by means of my spectroscope the quantity of sodium present amounts only to the 18-millionth of a grain, the spectroscope is perfectly competent to take up that minute quantity, and bring it out into daylight, so as to be detected with certainty. This reaction of sodium is so delicate, that if we examine any flame, burning in air, we almost invariably find sodium in it, for every particle of dust is impregnated with a sodium salt, probably sodic chloride. This is not to be wondered at, as two-thirds of the earth's surface is covered by sea, which contains a considerable amount of sodium salts, and the fine spray, which is continually caused by the dashing of the waves, evaporates and leaves *minute* specks of salt which are carried over the whole land, and make themselves visible in our spectroscopes. Take another instance. Lithium is a substance the knowledge of the existence of which as a common element we owe entirely to the spectroscope; the 6-millionth part of a grain of this can be detected. If we examine anything for lithium, and do not get the characteristic red line, we know that not even the 6-millionth of a grain is present. Strontium, again, can be discovered if only a millionth part of a grain is present. So much for the great power of spectrum analysis in its physical applications, and its dealing with minute quantities of the elements which we know already, and this of itself would be of enormous importance.

But the spectroscope does not stop here; it discovers the known elements under conditions where detection seemed almost impossible, and in which the old chemistry was powerless to help us. Let us take, again, for instance, lithium. Lithium was only known formerly to exist in four minerals; it is now known, thanks to the spectroscope, to exist almost everywhere. If we were to take the ash of a cigar and introduce it into a colourless gas flame and examine the colouration with the spectroscope, we should get a spectrum of lithium; and if we analysed in the same way the ash of milk, or the ash of blood, or of grapes, tea, sugar, &c., we should also find it. Dr. Miller has shown that, in the Wheal Clifford mine 800 lb. of this salt are given every 24 hours, though before the advent of spectrum analysis no lithium was known to exist there. It has also been found in meteoric stones, in the water of the Atlantic, &c. Surely this is an application of very great importance.

Another extremely important point about spectroscopic analysis is that, although we may have to analyse a complicated mixture of substances, the spectroscope is perfectly competent to deal with them. The characteristic lines for each element must stand out and be visible whether the substance be simple or complex. Thus, for instance, if we mix together some sodium and lithium, and place some of the mixture in a flame, we shall see nothing but the brilliant yellow colour due to sodium, the crimson flame of the lithium being entirely hidden. A moment's examination with the spectroscope, however, is sufficient to show us that both lithium and sodium are, without the slightest doubt, present in the flame; for both the yellow and red lines stand out as distinctly as they did when the simple salts were experimented with. The presence of lithium, indeed, may be detected, even if it be mixed with ten thousand times its bulk of sodium compounds.

But, further, spectrum analysis is not satisfied with showing us sources of known elements. It discovers new elements altogether. In 1860, Bunsen happened to be examining with a spectroscope the result of one of his analyses of the waters of a spring near Dürkheim, and he saw some lines which he had never seen before, although he had very carefully mapped the spectra of the known elements. Bunsen, as you know, is a very resolute chemist, and what he did was this. Having faith in his instrument, he evaporated no less than forty-four tons of the water of this spring, and out of these forty-four tons he got about two hundred grains of what turned out to be a new metal, which he called Cæsium. Rubidium was the next metal which was discovered in this way. Take another instance, the discovery of thallium by Mr. Crookes. Mr. Crookes was working with a seleniferous deposit from the Hartz mountains, when, by the aid of the spectroscope, he discovered this metal, which, I am informed, is now extensively used in the manufacture of fireworks. The spectrum of this metal is extremely distinct and beautiful, and you will understand why it has been named thallium, from the Greek word for a twig, on account of the beautiful green colour of the single line ordinarily visible.

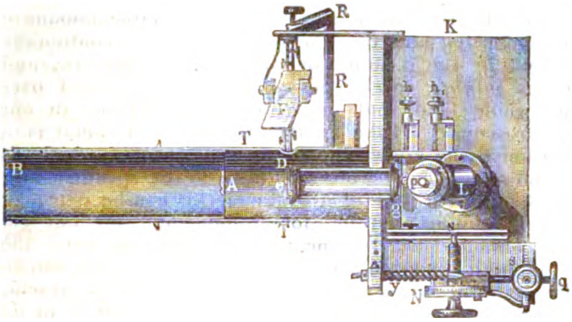

Fig. 27.—Side view of Star Spectroscope, showing the arrangement by which the light from a spark is thrown into the instrument by means of the reflecting prism *e*, by a mirror F.

A fourth element has been discovered by means of the spectroscope by two German chemists, Professors Reich and Richter, who were experimenting on zinc blend, and found two unknown indigo bands in the spectrum, which they successfully traced to the existence of a small quantity of a new metallic element, which has been named Indium.

You all know how important chemical analysis is in thousands of things connected with the arts, manufactures, and commerce, in detecting adulteration for instance, and in these matters the spectroscope gives our chemists a power which was undreamt of a few years ago.

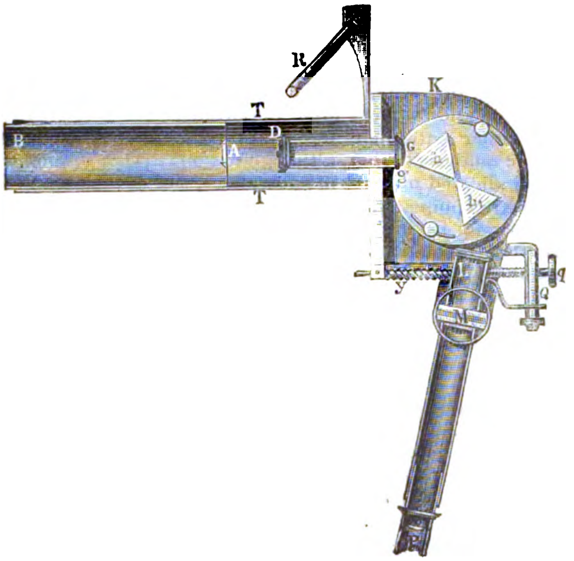

Fig. 28.—Plan of Star Spectroscope. T, Eye-piece end of telescope: B, Interior tube, carrying A, cylindrical lense; D, Slit of spectroscope; G, Collimating lens; *h h*, Prisms; Q, Micrometer.

There is another very beautiful application of the spectroscope which perhaps many of you will say is of more practical importance than those I have already brought to your notice. You know that, in the Bessemer process five tons of cast iron are turned into cast steel in twenty minutes. Now steel is only cast iron minus some carbon. It is clear, therefore, that the process depends upon getting rid of the carbon. How then can the spectroscope aid us in determining the time at which the carbon is got rid of? Nothing is more easy. The heat from the incandescent iron is so intense that the vapour of the different substances mixed with it is visible above the retort in which the metal is placed, and we get, so to speak, an atmosphere of incandescent vapour surrounding the cast iron. When we examine these incandescent vapours by means of a spectroscope, it is found that the spectrum changes very considerably at different times during the combustion of this cast iron. Now it so happens, that the process of conversion is such a delicate one that a mistake of ten seconds either way spoils the whole five tons which are being operated upon. You will see in a moment, therefore, that this is a case in which any rule-of-thumb or very rough method might now and then lead to a mistake; but when the spectrum of these incandescent vapours thrown out by the cast-iron is examined very carefully by means of a spectroscope, it is found that at the first the spectrum of carbon is quite visible, but at the right moment, which has been found by practice, that spectrum disappears, the combustion having been sufficient. All we have to do now, to ensure the charge being properly turned out, is, therefore, by means of the spectroscope, simply to watch certain lines in the spectrum, and when they show signs of disappearance say "Now," and the thing is done without any possibility of error. This is an instance of the practical application of the spectroscope in one direction; now let me give you one in another.

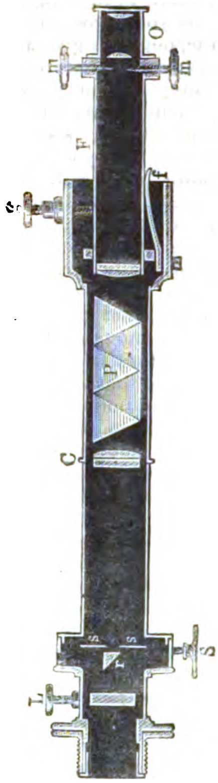

Fig. 29

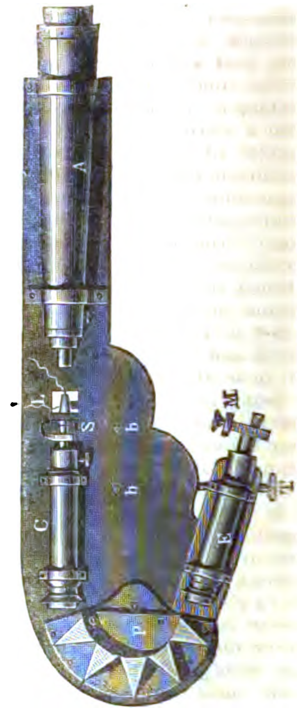

Fig 30.

Fig 29.—Direct vision Star Spectroscope. Fig. 30.—Sun Spectroscope. A, Telescope; S, Slit; P, Prism plate; E, Observing telescope; M, Micrometer.

When Dr. Bence Jones wished to determine some questions connected with chemical circulation, he employed the spectroscope with great success. Many of you, at the first blush, would be inclined to say it was not very likely that the spectroscope would help us here. If it were a question, for instance, of our own chemical circulation, we would not relish the idea of being converted into an incandescen vapour for the pleasure of testing a theory. But, fortunately, there are such things as guinea-pigs, and Dr. Bence Jones, by studying the vapours of the ashes of these animals, has arrived at some results of extreme importance. His *modus operandi* was as follows :—He gave the guinea pigs chloride of lithium, and then the question was to find, by burning the ashes of the different parts of the guinea-pigs, variously removed from the fountain of circulation and from the ordinary ducts of the body, to ascertain how long it took lithium to get absorbed into every part of the body. The most distant part, as far as circulation goes, is the lens of the eye. If, then, we give a guinea-pig chloride of lithium, then kill the guinea-pig, and examine the ash of the eye lens, say three hours after the lithium has been taken into the system, and if we find the lithium line in the spectrum of the ash vapour where no lithium was before, that is to say, if by means of the spectroscope we see that line which we have seen characterises the lithium spectrum, we know that the chemical circulation of the body is such as to take lithium through the body to that particular point of the circulation in that time. In the human subject Dr. Bence Jones has hit upon a very practical method of arriving at something like the same conclusion, by examining the spectra of the ashes of cataracts.

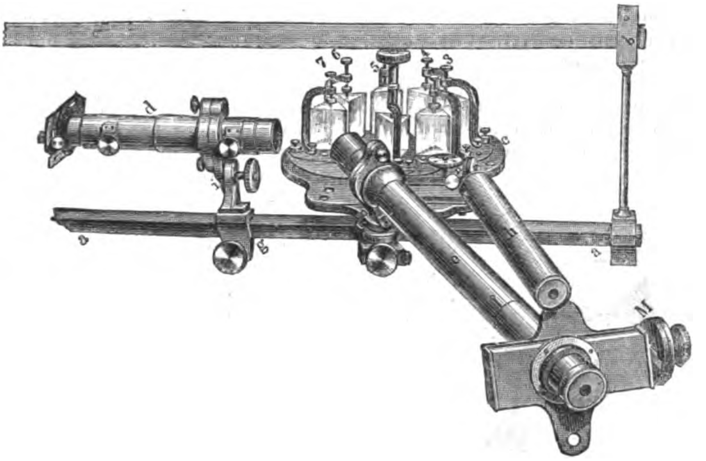

FIG. 31.—Sun Spectroscope. *d*, Collimator; *e*, Observing telescope; *h* and M, Two micrometers; 1, 2, 3, 4, 5, 6, 7, Prisms.

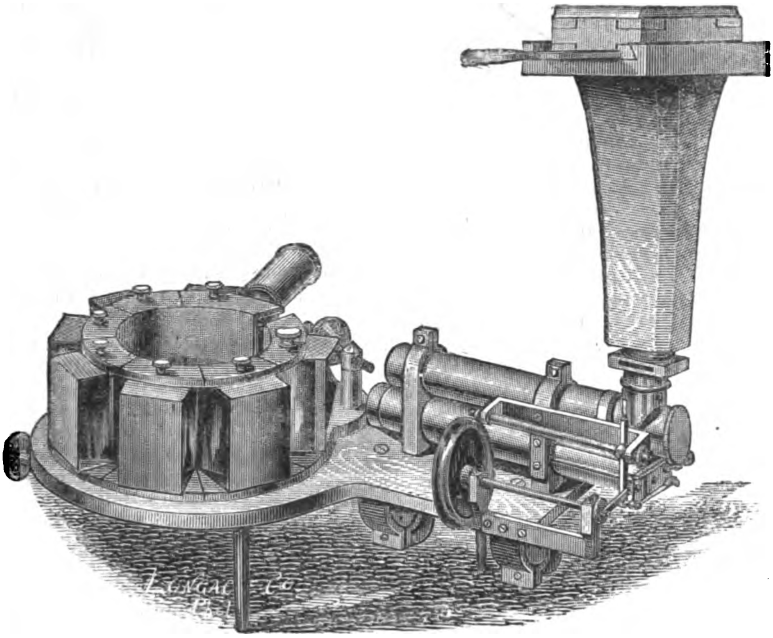

FIG. 32.—Sun Spectroscope arranged for photography.

So far as I have dealt with the applications of the spectroscope, up to the present time, I have dealt in the main with the application to chemistry and to physics, in other words, to the examination of light given out by terrestrial substances ; but I must now, with your permission, take you to the skies, reminding you that at present, I am merely dealing with the giving out of light, and with light emitted by celestial objects. We shall afterwards have to deal with the stopping or absorption of light, by vapours and other transparent media when the light passes through them.

I have already referred to the special fittings that were necessary for the application of the spectroscope to the telescope, and I think on carefully looking at the engraving (Figs. 27 & 28) representing a star spectroscope, you will see exactly how the spectroscope is applied to a telescope. We must now go a little more into details. One class of spectroscopes, as applied to telescopes, is arranged for observing the spectra of the stars, nebulæ, &c., and another with a much greater dispersive power for observing the spectrum of the sun.

In both spectroscopes the arrangements employed are similar, and resemble those of the instruments that have been already described. A finder on the side of the large telescope enables the image of the star to be brought on the slit, while, in the case of the sun, its image is received on the slit screen, and any part of the image may be brought on the slit by mere inspection.

The spectroscope is attached to the eye-piece end of the instrument, and the image formed by the telescope is received on the slit plate. Arrangements are necessary in the case of the star spectroscope for widening out the spectrum ; this is done by a cylindrical lens (as before explained); and for obtaining a spectrum of comparison, this is done by reflecting into the instrument the light emitted by an electric spark.

In the star spectroscopes, the number of prisms, and the consequent deviation and dispersion, is small. The accompanying woodcuts will make their detailed construction quite clear. In the case of sun spectroscopes, the deviation and dispersion required are large, the deviation amounting to over 300°; that is to say, the ray of light is bent through almost a complete circle; the light from stars is dim, and many prisms cannot be employed to widen out the spectrum, but in the case of the sun, there is light sufficient to give us a bright spectrum after it has been enormously dispersed.

Figs. 31 and 32 show a very powerful spectroscope to be attached to the telescope for observing the spectrum of the sun. One peculiarity of the instrument in Fig. 33 is that the ray of light having passed once through the lower part of the train of prisms, is received by a right-angled prism, which totally reflects the light twice, sending the ray of light back through the upper part of the same prisms, when it is again refracted; we thus have, by using these prisms, the same effect as if thirteen prisms had been employed. The ray of light enters the instrument by the lower tube, and after passing first through the lower half of the prisms, and back through the upper half, is received in the upper tube, and reflected upwards for convenience of observation. These prisms are so arranged, that whatever part of the spectrum is being observed, they are always at the angle of minimum deviation for this part of the spectrum, a very important point, as if this is not attended to the spectrum loses much of its brilliancy and sharpness. This is done either by attaching the prisms to a spring of ebonite or gun metal moving on a fixed point near the first prism of the series, as in the arrangement shown, or each prism may be attached to a radial bar acting on a central pin, as shown in Fig. 33.

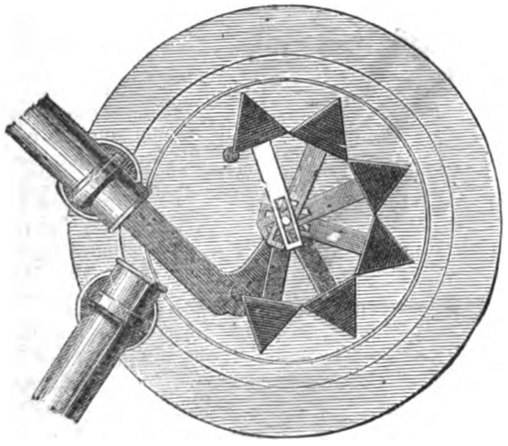

Fig. 33.—Automatic arrangement for securing the minimum deviation of the observed ray.

J. Norman Lockyer

(*To be continued.*)

HUNTERIAN LECTURES BY PROF. FLOWER

Lectures IV. V. VI.

It will not be necessary in describing the fossil remains of mammalia to devote any time to the consideration of the Monotremata, for though it might have been supposed that these animals, the Echidna and Duck-bill, on account of their being the lowest in the scale, would have been largely represented in ancient times, evidence to that effect has not been forthcoming. In the post-pliocene of Australia, the lower end of the humerus of a large Echidna, was found by Mr. Krefft, curator of the Museum at Sydney, and that is apparently the only recorded specimen from the class. With regard to marsupial animals the case is very different, and the remains prove that their geographical distribution formerly was not at all what it is now, when they are confined to Australia, the Austro-malay Archipelago, and South America. The family may be classified by the teeth or by the feet. According to the former method the Kangaroos, Phalangers, Koalas, in which there are only two lower incisors, without persistent pulps, form one herbivorous group; the Wombats a second; and those with more than two lower incisors, including the Bandicoots, Dasyures, Thylacine, and Opposums, a third carnivorous section. If the structure of the feet be taken as the main point, the tendency to the reduction of the second and third digits places the Bandicoots with the Kangaroos, instead of with the Dasyures, and does not otherwise modify the arrangement. The at first sight great difference between the molar teeth of the Thylacine and the Kangaroo can be easily bridged over by a comparison of intermediate forms; looking for instance at an upper molar in the latter, its crushing surface presents two broad ridges, with an intermediate depression, in which there is an oblique groove. In the Thylacine there is a central large, and two lateral smaller tubercles, with a band connecting the medium with one of them. There is also a small posterior and two very small anterior tubercles in the cingulum. In Perameles the molar presents two rows in a double crescent, in front of which are four minute processes, which represent those of the cingulum of the Thylacine, the crescents being representatives of the big tubercles. In the Kangaroo Rats the tubercles alone remain, and in the Kangaroo these blend to form the ridges.

Respecting the fossil forms, those from the Purbeck beds have been thoroughly worked out by Prof. Owen. With the exception of *Plagiaulax* they belong to the polyprotodont division, and nearly all have more than seven teeth of the molar series, *Triconodon* and *Triacanthodon* being the exceptions, they also being peculiar and differing from all existing Marsupials in having four premolars and three molars. There is no evidence to show whether there was any succession of the teeth. *Plagiaulax* has been the subject of one of the most important controversies in connection with palæontology, between Prof. Owen and the late Dr. Falconer, the former maintaining that it was carnivorous, eating the lizards found with it; Dr. Falconer that it was herbivorous and allied to *Hypsiprymnus*. The fact of its having only two lower incisors, and that the molars are hypsiprymnine in form tends to show that it must have had some relation to the herbivorous group, and shows that at so ancient a date the family had already divided in the manner that we now find it.

The tertiary Marsupialia must next be considered. In the Eocene gypsum of Montmartre several small skeletons have been found, clearly referable to the Opossums, and with a similar dentition, from which Cuvier was able to classify them correctly and predict the existence of marsupial bones in the uncovered skeletons. From Auvergne three similar miocene species have been described, and in England Mr. Charlesworth has, on undoubtedly insufficient evidence, referred a premolar to the same genus, Dideiphys. The Yale College expedition have obtained, among the large number of bones that they have collected, some which Prof. Marsh thinks are Marsupial. In the Pliocene there have not been any fossil remains of this sub-class yet obtained, but many in the Quaternary period. In the Brazilian caves Opossums have been found in abundance, and in the Wellington Valley and many other parts of Australia extremely interesting forms have been obtained, which must be referred to more fully. Prof. Owen has studied them in great detail. The remains may be divided into two divisions; (1), those allied to existing genera; and (2), those not now represented. With regard to the former it is interesting to observe that the Thylacine and Ursine Dasyure, now restricted to Tasmania, at one time abounded on the mainland. There are also remains of enormous Wombats and

Kangaroos, and the Kangaroo-rats were well represented. Of the genera now unrepresented *Diprotodon* was one of the largest; it was the size of the biggest existing Rhinoceros; only one species is known. Excepting the skull the bones are not well known, the feet and several other parts not having been obtained. There was a strong descending process from the zygoma. The dental formula is represented thus: i. $\frac{3}{1}$. c. $\frac{0}{0}$.m. $\frac{1+4}{1+4}$. The middle anterior incisors and those of the lower jaw closely resemble those of the Rodentia on a large scale; they grew from persistent pulps. The upper lateral incisors were small and had closed roots. Between them and the molars there was a gap. The molars were double crested, with four roots in the upper and two in the lower. Its dentition allies it with the Kangaroo, but from the bones that are known it is probable that its proportions were more that of the Wombat, the femur being longer than the tibia, and of the same length as the humerus. The femur was singularly compressed. Another genus, *Nototherium*, was still more extraordinary; it was first supposed to have no lower incisors, but this was subsequently proved to be incorrect. Mr. Macleay, after Prof. Owen's description of the genus from lower jaws only, obtained upper jaws of an animal, called by him *Zygomaturus*. Prof. Owen stated, and apparently with very good reason, that this was nothing but the upper part of the skull of his *Nototherium*. In this genus the zygoma is enormous in all directions and at the extreme anterior root has a descending process. Its dental formula is i. $\frac{3}{1}$. c. $\frac{0}{0}$. m. $\frac{5}{5}$, resembling Diprotodon, except that the incisors in upper and lower jaws are all rooted. Three species have been described, and no bones of the body have been found. In the museum of the College there is an astragalus, very Wombat-like, and also an atlas which agree well in size with what would have been expected in such an animal, which for other reasons was probably intermediate between the Kangaroos and Wombats.

Thylacoles is the last of these extinct marsupials; none of the bones, except of the head, have been found; the zygoma and the angle of the lower jaw are still unknown. As far as can be determined, it apparently approaches nearest to the koala. The teeth are quite peculiar to the genus; the dental formula is i. $\frac{1}{3}$. c. $\frac{1}{0}$. p.m. $\frac{3}{1}$.m. $\frac{1}{32}$. The incisors in both jaws are much as in the phalangers, the median being large and with closed roots. Then follow two small lateral teeth in the upper jaw, behind and *internal* to which is an almost hidden canine, partly covered posteriorly by two small premolars. The characteristic tooth, an enormous elongated and flattened last premolar comes next. This peculiar tooth is evidently that which replaces the only one lost in this class of animals, and which is always large, particularly in the kangaroo-rats. Internal to the posterior border of this tooth the minute true molar stands, just as in the cats. In the lower jaw two rudimentary teeth are sometimes present, followed by the peculiar large premolar, and that by two small molars. The muzzle was blunter than in most existing diprotodonts. The stunting of the molars is correlative with the great development of the extraordinary premolar undoubtedly. Prof. Gervais has taken a cast of the interior of the skull, and considers that the brain approaches the wombat most nearly. Prof. Owen originated and still strongly supports the idea that *Thylacoles* "was one of the fellest and most destructive of predatory beasts." Mr. Krefft, of Sydney, was the first to call his opinion in question, and he gave a conjectural restoration of the then unknown anterior part of the skull and incisor teeth, which subsequent discoveries have in great measure confirmed. No doubt its nearest alliances are with the phalangers and kangaroos, which are neither of them carnivorous. In the carnivorous marsupials, as in the cats, the canines are large and the incisors small. It is probable that the uniqueness of the dentition indicates a peculiar diet, perhaps some form of food, of a vegetable nature, which has disappeared, as has its consumer. Claws have been found, probably of this animal; they closely resemble those of the phalangers.

NOTES

Dr. Debus has been appointed Professor of Chemistry at the new Naval College.

It is rumoured that Prof. James Thomson of Belfast will succeed to the Chair of Engineering at Glasgow University, vacant by the death of Prof. Macquorn Rankine.

Sir John Lubbock will, to-night, at half-past eight, lay before the Society of Antiquaries the results of his researches during a tour last autumn respecting the site of Troy.

According to a Berlin telegram, another coal-field of apparently gigantic dimensions has been discovered in Central Asia—the Chodshent district, near Sir Darya.

The *Times* understands that an intense magneto-electric light and an exceedingly powerful gaslight will shortly be exhibited simultaneously on the north and west sides of the upper part of the Westminster Clock Tower. The current in the former will be generated by a comparatively novel and remarkable magneto-electric machine moved by steam power, which a high authority in this country pronounces to be a decided step in advance of every other machine of the kind. The latter is in operation at various lighthouses on the Irish coast, and may in favourable weather be seen at the distance of twenty-five miles. The exhibitors have proposed that the trial shall be made at their own cost, except in very trifling particulars.

We learn with regret that Mr. J. Glaisher, F.R.S., has resigned the secretaryship of the Meteorological Society, an office which he has held continuously (except during his presidency) from the foundation of the society, of which he was one of the earliest promoters, in 1850.

The Vice-Chancellor of Cambridge has appointed Prof. Tait, of Edinburgh University, Rede Lecturer for the ensuing year. Prof. Tait will deliver his lecture in the Easter term.

An influential committee has been formed at Cambridge of members of the University and others for the purpose of having a portrait of Prof. Cayley painted and presented to Trinity College. A considerable portion of the sum required has been already promised. The portrait, which is being painted by Mr. Lowes Dickenson, is of the same size as that of Sir William Thomson, by the same artist, that has been recently placed in the Combination Room of St. Peter's College. The movement is supported by all members of the University, irrespective of college, and other admirers of Prof. Cayley's mathematical discoveries; the only reason for the presentation of the portrait to Trinity (the professor's own) College being that there is no public building in the University appropriate for the reception of portraits of distinguished members of the University. Everyone will be pleased at the compliment which will thus be paid to the most illustrious English mathematician of the age. Subscriptions may be sent to the treasurer, William Walton, Esq., Trinity Hall.

At the Annual Meeting of the Geological Society on February 21, the Wollaston Gold Medal was awarded to Sir Philip de Malpas Grey-Egerton, Bart., F.R.S.; the balance of the proceeds of the Wollaston Donation Fund to Mr. J. W. Judd, F.G.S.; the Murchison Medal to Mr. William Davies, of the British Museum; and the balance of the Murchison Fund to Prof. Oswald Heer of Zürich.

We learn that the University of St. Andrews has conferred the degree of LL.D. on Mr. E. B. Tylor, author of "Primitive Culture."

The Royal Commission for Scientific Education and the Advancement of Science still continue their sittings.

At the general monthly meeting of the Royal Institution this week at which Prof. Tyndall was present for the first time since his return from America, a resolution was unanimously adopted congratulating the Professor upon his safe arrival in England, expressing satisfaction that the people of the United States had shared in the advantages of his teaching, cordially welcoming him on his return to his own scientific home, and wishing him continued health and prosperity. Prof. Tyndall was also thanked for his generous gift to the Institution of the splendid and extensive apparatus employed by him in his lectures in America, and congratulated on the liberal spirit, and the love of science, which has led him to appropriate the profits of his lectures in the United States to the establishment of a fund to assist the scientific studies of young Americans in Europe.

Dr. Petermann has received news from Africa that Mikluchs Maclay, the Russian Traveller who was believed to be dead, is alive and well in New Guinea.

Physical science in America has experienced a great loss in the death, in the sixty-seventh year of his age, of Prof. James Henry Coffin, of Lafayette College, this sad event taking place on the 6th of February. Prof. Coffin was a native of Massachusetts, and for a time a professor in Williams College, where he planned the construction of Greylock Observatory on Saddle Mountain. He became a member of the faculty of Lafayette College in 1846, where he has since filled the chair of mathematics and astronomy. Prof. Coffin is best known from his treatise on the "Winds of the Northern Hemisphere," published by the Smithsonian Institution in 1851. At the time of his death he was engaged in a second edition of this work, brought down to the present day, and extended so as to embrace the entire globe. He was a member of the National Academy of Sciences. It is quite a curious coincidence that Captain Maury and Prof. Coffin, who have given so much attention to the subjects of atmospheric currents, should have died within a week of each other, and at the same age.

When is the foundation-stone of our grand new Natural History Museum to be laid? Is Government waiting for the advent of fine weather in order that the ceremony may be as auspicious and imposing as possible? We can hardly believe the current gossip that the fiscal authorities of the country have quietly retired the thousands said to have been voted for the purpose, in order that a saving might be effected in their expenditure, and a handsome surplus be vaunted of in the forthcoming budget. Meanwhile see what our young, energetic, long-headed cousins on the other side are doing. A new Natural History Museum is about to be erected in New York 800 feet long by 600 wide, which will be the largest building in America. 100,000*l.* was voted last winter by the legislature to commence it, and 200 men are already blasting for its foundations. It is eventually to cost 2,000,000*l.* sterling, and fifteen years will be occupied in its construction. This great building is to cover fifteen acres of ground, and is to be situated on Montallan Square, facing Eighth Avenue and Central Park. The front portion is to be finished directly, and the back portion is to be finished from time to time as needed, and as appropriations are made for it. The material is to be granite. The building is to be four stories high, with students' rooms in the upper story, and rooms and shelves for specimens illustrating natural history, zoology, botany, and mineralogy, on the ground floors. The architecture of the building is to be a kind of French *Renaissance*, similar to the Luxembourg or the buildings around Fontainebleau.

A magnificent present of Peruvian skulls has lately been received by the Anthropological Institute from Consul Hutchinson of Callao. This highly instructive series consists of 150 specimens dug out—not gathered from the surface—of the old aboriginal burying grounds of Pasamayo and of Ancon, 20 and 30 miles north, and from Cerso del Oro about 100 miles south of Callao. Twenty-four of these were taken by the Consul himself from the Huacas of Ancon, and are probably those of Chinchas or perhaps Aymaras. We recommend all anthropologists to take the opportunity now afforded for a few days, of visiting the collection which may be seen daily from 12 to 4 at the rooms of the Institute. It is expected that the President (Prof. Busk) and Dr. Barnard Davis will each contribute notes on the more remarkable of the skulls at the meeting to be held on the 18th inst.

Prof. Van der Sunde Bakhuyzen has been appointed to the directorship of the Leyden Observatory, the head-quarters of Dutch astronomy, as successor to the late Prof. Kaiser, whose death we noticed in Nature, vol. vi. p. 354. Prof. Bakhuyzen was a pupil of Kaiser's.

We hope shortly to give a brief notice of some recent works on the Echinoderms, but in the meanwhile it may be well to mention that the following important contributions to our knowledge of this group have within the last few weeks been published. (1) Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College. No. vii.—Revision of the Echini; parts 1 and 2 with forty-nine plates. Part 1 contains Introduction, Bibliography, Nomenclature, Chronological List, Synonymy, Geographical Distribution; Part 2 contains Echini of the eastern coast of the United States. (2) "Ophiuridarum novarum vel minus cognitarum descriptiones non nullæ," by Dr. C. Lütken. In this there is a most interesting chapter on spontaneous division in star-fishes. (3) On the Ophiuroids collected by Dr. Goës in the Josephine Expedition, with a Conspectus generum Ophiodermatidarum, by A. Ljungman. (4) A modest catalogue of the Echinodermata of New Zealand, with diagnoses of the species, by Captain F W. Hutton. The first memoir in this list will mark an e study of the Echini.

Prof. Hyatt, of Cambridge, Mass., by means of sections of the central spirals of Ammonites and Goniatites, has been able to obtain some valuable results on the subject of the Embryology of Fossil Cephalopods. He finds that the shell in its first stage is represented by a globular sac, which is not retained in Nautilus. Into this sac opens the first whorl of the shell, and the others are coiled round it. Prof. Hyatt has endeavoured to prove that the series of forms, so well known as depending on the amount of coiling or uncoiling of an elongated cone, is epitomised in the life of the individual Nautilus or Ammonite, the young being at first uncoiled, and the different degrees of coiling up finding a permanent expression in the genera of Ammonitidæ.

Ornithologists will be glad to hear that a new Indian ornithological journal entitled *Stray Feathers*, has just been started by Mr. Allen Hume, and published at Calcutta. The introductory number contains the first of a series of articles by the Editor, on the birds of Sindh, which will be welcomed by many. It also includes the first draught of a "Conspectus of the Avifauna of India and its dependencies," now in course of publication.

The discovery of the African money cowrie (*Cypræa moneta*) in the barrow graves of Pomerania, in 1868, has had the effect of exciting much speculation among archæologists, as to the mode in which they could have been introduced into the country. Some twenty-seven of them were found in an earthen vase mixed with earth and sand, each one being notched so as to permit its being arranged with others upon a string. Wagner is of the opinion that these shells must have been brought by the Phœnicians for the purpose of bartering with the people for amber. A closely allied species (*C. pantherina*) was found in graves in Swabia, which could not in any way have been associated with the Phœnicians. Jeitteles also mentions the occurrence, among certain prehistoric objects found near Olmütz, of a coral from the Indian Ocean, found very rarely in the Mediterranean.

MR. EDWARD A. BLYDEN has lately presented to Governor Hennessy, of Sierra Leone, a report of his mission to Falaba, in Africa, early in the year 1872. His route carried him through a considerable portion of the less-known region of Eastern Africa, and much information was derived, which it is proposed to embody hereafter in a detailed work.

THE report of Major Powell of his survey along the Colorado of the West, during the year 1872, has just been printed by the U.S. Congress, and embraces as its most striking feature an account of a remarkable series of folds and faults in the earth's strata, of the highest interest to the geologist. Numerous practical results of value are recorded, especially the discovery of coal, salt, and metals. Very large collections of special ethnological interest were gathered. An appropriation of 20,000 dols. is asked for by the Major to continue the work during the current year.

A BILL is now before Congress providing an appropriation of 20,000 dols., or as much thereof as may be necessary, for the purpose of having printed, at the government printing office, one thousand copies of the "Descriptive Anatomical Catalogue of the Army Medical Museum."

MR. JOHN MUIR, in the *Overland Monthly*, announces the existence of actual glaciers in the Merced group of Californian mountains, and remarks that the snow banks of Mounts Lyell and M'Clure, of the Yosemite region, are true glaciers as shown by the forward movement of stakes planted by him across the bank. The central stakes were found to move forty inches in forty-six days, while the surroundings exhibit all the peculiarities of glaciers in the form of moraines, &c. The Mount M'Clure glacier is about half a mile in length, and of the same breadth in the broadest part, and the Mount Lyell glacier is about a mile long.

A BILL has passed one branch of the Legislature of Michigan establishing a commission of fisheries, and appropriating 10,000 dols. for two years for purposes connected with the increase of food fishes in the State.

IN the *Australian Mechanic* for December, a proposal is mooted for the formation of an association in the southern continent, similar to our own British Association.

WE learn from the same journal, that a society is in course of formation in Victoria, on the basis of the London Society of Arts.

ON Feb. 9 there was a shock of earthquake at Antioch.

ON February 10 there were earthquake shocks felt at Durazzo in Turkey, and the 11th at Kavalla in Macubria, and on the 12th at Jajat also in Turkey; these were serious in their consequences.

ON Feb. 14 there was an earthquake at Sour (Tyre), Akka (St. John d'Acre) and Jerusalem. On the same day there was a hot stifling wind on the same coast, at Beiroot, which made breathing difficult. As the Imperial Meteorological Observatory at Pera, Constantinople, is now constituted under M. Coumbary, with the aid of widespread telegraphs, we shall get better records of the earthquakes over the large districts of the Turkish empire. Hitherto our information chiefly depended on the chance intelligence obtained by M. Charles Ritter, of the Ponts et Chaussées, and transmitted to Paris.

IN the *Calcutta Englishman* "A Bengalee" calls in question Mr. Darwin's statement that Bengalees shrug their shoulders. He says he remembers having seen several of his countrymen, who had adopted English ideas and habits, shrug their shoulders, but never has he observed it in any unsophisticated Bengalee. The remonstrance shows how widely the study of Mr. Darwin's works is disseminated.

A NEW Octopus has been added to the Brighton Aquarium, in room of the one whose unfortunate end we recently chronicled.

WE learn from *Les Mondes* that under the superintendence of M. Geoffroy Saint-Hilaire, the sad havoc made during the late war upon the Paris *Jardin d'Acclimatation* has been nearly repaired. The collection of animals now numbers 6,148 head, valued at 158,370 francs; very nearly 5,000 animals have been added during 1872. The number of visitors during the past year has been 238,000.

A PRELIMINARY meeting of skilled workmen was held on March 1, at the offices of the Working Men's Club and Institute Union, at which it was decided to form a Trades Guild of learning, with a view of enabling skilled workmen to acquire a knowledge of history, political economy, technical education, literature, science and art.

WE learn from the *Journal of Botany* that Dr. Ernst of Caracas has been named by the Government of Venezuela to fill the chair of botany in the University of Caracas, where Natural History has hitherto never been taught. He is likewise commissioned with the foundation and management of a small botanic garden and the correspondent botanic museum. For the garden he will have the two large yards of the University building, both together 1,300 square metres large, which will give about 800 square metres available ground for planting.

A CATALOGUE is printed by M. Rodembourg, head-gardener, and M. E. Morren, director of the botanic garden belonging to the University of Liége, of upwards of 200 species of the interesting order *Bromeliaceæ* cultivated in it,—an evidence of the zeal with which scientific botany is pursued in some quarters on the Continent.

WE see from the *Ceylon Observer* that that paper has been attempting to run a "pigeon express" between Galle and Colombo, and would very likely have succeeded, had not a bloodthirsty civet-cat wriggled herself between the narrow bars (1½ in. apart) of the dovecot, and killed off five of the finest pigeons in training; in every case it had cut the jugular vein and sucked the blood. The *Observer* hopes, however, that ere many weeks other pigeons, now in training, will be regularly bringing from Galle to Colombo the budgets of news, written and printed on thin paper for the special purpose.

THE additions to the Zoological Society's Gardens during the last week include a Rose hill Parrakeet (*Platycercus eximius*) and a Crested Ground Parrakeet (*Calopsitta novæ-hollandiæ*) from Australia, presented by Mr. Griffiths Smith. A Crested Screamer (*Chauna chavaria*) from Buenos Ayres, presented by Mrs. Wilson. Two Black-eared Marmosets (*Hepale penicillata*) from Brazil, presented by Mrs. Bischoffsheim. A White-throated Capuchin (*Cebus hypoleucus*) from the U.S. of Colombia; a Puma (*Felis concolor*) from Cartagena; an Ocelot *Felis pardalis*) from Savanilla; and a Prince Albert's Curassow (*Crax Alberti*) from Cartagena, purchased.

THE THEORY OF EVOLUTION IN GERMANY

PROF. HAECKEL, of the University of Jena, may be regarded as the most eminent living representative of the doctrine of evolution in Germany. He has won a name for himself during the last ten years as the author of several remarkable works in various sections of Natural History; specially should be mentioned his monograph on the *Radiolaria* (Berlin, 1862), which is, according to Huxley, one of the most solid and important contributions to zoology that have appeared for a long time. We owe also to him a monograph on the Monads (*Journal de Jena pour la Médecine*, &c., 1868), the simplest of known organisms, and another on the *Geryonidæ* or *Hydromedusæ* (Leipzig, 1865); a history of the development of the *Siphonophoræ*, a work crowned by the Academy of Utrecht (1869); a paper on the Sarcode bodies of the *Rhizopoda* (in the *Journal de Zoologie Scientifique*, Leipzig, 1865); "Considerations on the Division of Labour in Nature and among Men" (in the collection of scientific treatises of Virchow and Holzendorff, 1869); and an essay on the "Origin and the Genealogical Tree of the Human Race" (in the same collection, 1868; 2nd edition, 1870). There has just appeared a monograph on the Calcareous Sponges (See NATURE, vol. vii. p. 279), on which the author has been engaged for five years. But his principal work is undoubtedly his "Morphology of Organisms," in which he has condensed the result of all his researches, and unfolded his views on Nature as a whole, its history, its constitution, and its development: it is a learned treatise on natural philosophy, in which the author has adopted out and out the system of Darwin. Indeed, on more than one point he goes much farther than his master, and does not shrink from any of the extreme consequences of principles which are simply stated by the English philosopher: it may with truth be said that he is more Darwinian than Darwin himself. He aims, in fact, at filling up the chasm which separates the organic and inorganic kingdoms, and is inclined to endow with life everything that has being, down to crystals and the smallest molecule of matter. Haeckel, with his comprehensive and philosophic mind, has more than once applied the theory of evolution to certain moral phenomena, and notably to politics, while Darwin has always shown considerable reserve in this direction. With respect, also, to the simian origin of man, he is much more explicit and precise than the English naturalist. In short, as he does not confine himself simply to the exposition of theories and principles, as he seeks to recover the marks of development in the particular genealogy of animal and vegetable organisms, he is compelled to commit himself to a great number of hypotheses, whose boldness it is impossible to deny. We do not speak thus in the way of reproach; we are none of those who think that science can live on experiment alone; hypothesis has always preceded experiment, and has seemed to incite and throw light upon it; it is the torch of induction, and without it the human mind would be doomed to sterility. Goethe has truly said that bad hypotheses are better than none at all. All that we ought to insist on is, that a hypothesis be abandoned the moment it is found to contradict certain facts, or when the same facts are more satisfactorily explained by a new hypothesis. One hypothesis may be better than another in three points—(1) when it accounts for a greater number of facts; (2) when it explains them by a smaller number of causes; and (3) when it makes use only of known causes, and involves a smaller number of accessory hypotheses. This is why Darwinism is preferable to supernatural hypotheses; it only applies to the whole round of natural phenomena causes which undoubtedly explain particular facts—natural selection, adaptation, and heredity.

Haeckel has with justice observed that if the doctrine of evolution has not yet been universally adopted, it ought to be attributed to the want of philosophic culture on the part of the great majority of contemporary naturalists; and this reproach is specially deserved by France, where Darwinism has hitherto been much less understood than in England and Germany. "The numerous errors of speculative philosophy during the first thirty years of our century have brought such discredit on philosophy as a whole among the advocates of the exact and empirical method, that the latter at present labour under the strange delusion that the edifice of the natural sciences can be built up by means of facts alone without philosophic connection,—with simple notions unenlightened by any general conception. If a purely speculative work undisturbed by the indispensable conditions of empirical facts is a chimerical edifice whose inanity is exposed by the first experiment, on the other hand, a purely empirical doctrine, composed exclusively of facts, is only a formless heap, unworthy of the name of structure. Rough facts are not the only materials; philosophic thought alone can rear them into a science. From this absence of the power of philosophising among naturalists proceed those gross mistakes in the elements of logic, that incapacity to draw the simplest conclusions, which are too clearly seen at the present day in all branches of the natural sciences, but particularly in zoology and botany." *

Haeckel has given a *résumé* of his theories as a whole in a series of lectures delivered at Jena in the Winter of 1867–68. These lectures have been re-published under the title of "Natural History of Creation" (Berlin, 1868; 2nd ed. 1870), in a volume which has already gone through several editions. What follows is an analytical exposition of the most important parts of this work. The three sections which immediately follow contain the substance of the 12th, 13th, 14th, and 15th lectures, which form a division of Haeckel's work under the title of "Principal Characteristics and Fundamental Laws of the theory of Evolution." Haeckel discusses those facts of Embryology, Palæontology, and Chorology, or the geographical distribution of living beings, which are calculated to throw light upon the science of the development of species.

Embryology

It is astonishing how much ignorance even now prevails upon the embryonic development of man and animals generally. Just as the originator of the theory of evolution—Lamarck—had to wait half a century before Darwin came to rescue his doctrine from oblivion, and impart to it new life, so Wolff's theory of Epigenesis, published in 1759, remained almost unknown till 1803, when there appeared Oken's "History of the development of the Intestinal Canal." It was only then that the study of Ontogenesis began to spread, and soon there appeared the classic researches of Pander (1817), and Baer (1819). The latter especially, in a book which marks an epoch ("History of the Development of Animals"), has established the most important facts of the embryology of the vertebrates with so much intelligence and philosophic depth, that his doctrines have become the indispensable basis for the study of that group of animals to which men belong.

At the outset of his existence, man, like every other animal organism, is only an egg, a simple little cell, whose diameter is only one-fourth of a millimetre at the most. It differs from the primordial cellule of the other mammalia only in its chemical constitution and the molecular composition of the albuminous matter of which the egg essentially consists. And yet these differences cannot be directly perceived by any means at our disposal; but we are compelled by indirect conclusions to suppose their existence as the prime cause of the difference in individuals. The human egg encloses all the essential elements of a simple organic cellule: a protoplasm which bears the name of *vitellus*, and a *nucleus* or germinal vesicle. This nucleus is a small sphere itself enclosing another nucleus much smaller still, the *nucleolus*; exteriorly the protoplasm is enveloped by a membrane which is known by the name of *zona pellucida*. The eggs of many of the lower animals, as the greater part of the medusæ, are on the contrary naked cells, which do not possess this envelope.

As soon as the egg of the mammal is completely developed, it leaves the ovary and descends, by the narrow canal of the oviduct, into the uterus, where, after fecundation, it becomes an embryo. This transformation is thus brought about:—the original cellule becomes divided into two cellules; on the primitive nucleolus are formed two new specks, and the nucleus becomes separated into two vesicles, each of which takes with it half of the protoplasm. The result of this process is that in the heart of the vitelline membrane, which alone is not divided, two cellules are found in juxtaposition, differing from the original only in being unenveloped. Each of these new cellules is in its turn divided into two others, so as to form four, which in the same way become eight, these eight, sixteen, and so on; these successive segmentations producing an agglomeration of cellules, in outward appearance resembling a mulberry. The further development consists in these cells assuming the shape of a sac (*vesicula blastodermica*), in the interior of which a liquid collects; shortly, on a point of the wall which is composed of these cells is produced a disc-like coagulation; their number rapidly increases, and this particular condensation becomes the embryo strictly so called, while the remainder of the blastoderm serves only for its nourishment. The embryo soon begins to broaden into the form of a biscuit. Three leaves or layers of cellules can be distinguished, superposed like envelopes upon each other, and each having its particular place in the construction of the living being; from the exterior leaf is formed the epidermis and the central parts of the nervous system, the spinal marrow and the brain; from the central layer is formed the interior membrane which lines the digestive canal from the mouth to the anus, with all the glands that are attached to it (the lungs, the liver, the salivary glands, &c.); the intermediate layer is the source of all the other organs.

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* Translated from an article by M. Léon Dumont in *La Révue Scientifique* for January 25, 1873.

* General Morphology, I. 63; II. 447.

The processes by which the three layers of cellules give birth to the most complicated organs can all be reduced—(1) To new segmentations, and consequently to an increase in the number of the cells; (2) To the division of labour or the differentiation of these cellules; (3) To the combination of these cellules, differently developed. The cellules which comprise a living organism may thus be compared to the citizens of a state, some of whom have one set of functions to perform, others another; the division of labour, and the organic perfection which results from it, enables the state to accomplish certain undertakings which would be impossible to isolated individuals. Every living organism composed of many cellules resembles a sort of republic capable of accomplishing certain organic functions, which could not be discharged by a single cell, an *amœba*, or a monocellular plant. No rational mind would seek to explain by superhuman intervention the public weal which accrues to political society, from the harmony of particular actions; so also in the organism, all the adaptations to ends ought to be regarded as the natural and necessary consequence of co-operation, of the differentiation and the perfection of the cellules, and not as the intentional work of a supernatural will.

Until the brain begins to show itself distinctly, it is scarcely possible to recognise any difference between the embryos of the different vertebrata, or at least of the three superior classes—reptiles, birds, and mammals. Why, then, should any one now refuse to admit the most important consequence of the theory of evolution, according to which men have descended from simious or even inferior mammals? Are the phenomena of the development of the individual man, the earliest characteristics of which are given above, less marvellous? Is it not in the highest degree astonishing that all the vertebrate animals, belonging to the most diverse classes—fishes, amphibia, reptiles, birds, and mammals—cannot, in the earliest stages of their embryonic development, be distinguished from each other, and that even at a much later stage, when reptiles and birds are distinctly separated from mammalia, man and the dog are still almost identical? The development of the individual (*ontogenesis*) is as difficult to explain as that of the species (*Phylogenesis*). It may be even said that it is still more so, seeing that it has an infinitely shorter time in which to be accomplished. The former is nothing more than a compact reproduction of the latter, and Haeckel rightly finds in this parallelism the most incontestible proof in favour of the theory of evolution. Man and the superior vertebrata reproduce in the earlier phases of their development conditions which last through the life of the lower orders of fishes; they then pass into forms which are characteristic of the amphibia; the marks of the mammalia appear only at a later stage, and even here are discovered a succession of degrees which correspond to the characters of different species or families. It is the same order in which the palæontological history of the earth shows us the successive production of the different animal forms—first the fishes, then the amphibia, next the inferior mammals, and last the superior mammals.

Side by side with these two orders of evolution there is a third parallel with them: it is that which is found particularly expounded in the works of Cuvier, Goethe, Meckel, Johannes Müller, Gegenbaur, Huxley, and forms the subject of comparative anatomy. This science seeks to determine what is common to the forms of different species, and studies living beings from the point of view of the scale of perfection. In this respect also we find that fishes, amphibia, and the inferior mammals stand in the same relation to man as from the standpoint of embryonic evolution and of palæontology. Now, this triple parallelism of individual development, of palæontological development, and of systematic development, is completely explained by the theory of transformation, by the laws of heredity and adaptation, while no opponent of the theory of evolution has ever been able to account for it in a natural and philosophic manner. Haeckel concludes from this that we shall be compelled to admit Lamarck's theory of evolution, if we are not led to accept Darwin's theory of selection.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Feb. 20.—"On the Anatomy of the Land Planarians of Ceylon." By H. N. Moseley, M.A., Exeter College, Oxford.

Two new species of Land Planarians from Ceylon are described as belonging to the genus *Bipalium* (Stimpson), *B. Ceres*, the other to that of *Rynchodemus*, *R. Thwaitesii*.

With regard to the habits of *Bipalium*, the most interesting facts noted are that these animals use a thread of their body-slime for suspension in air, as aquatic Planarians were observed to do for their suspension in water by Sir J. Dalyell, and the cellar-slug does for its suspension in air. The anatomy of the Planarians was studied by means of vertical and longitudinal sections from hardened specimens. The skin in *Bipalium* and *Rynchodemus* closely conforms to the Planarian type, but is more perfectly differentiated histologically than in aquatic species, and approaches that of the leech in the distribution, colour, and structure of its pigment, and especially in the arrangement of the glandular system. The superficial and deep glandular systems of the leech are both here represented. In *B. Ceres* peculiar glandular structures exist, which may foreshadow the segmental organs of Annelids, it being remembered that these segmental organs are solid in an early stage of development. Rod-like bodies are present in abundance, though, singularly enough, Max Schultze failed to find any in *Geoplana*. These rod-like bodies are probably homologous with the nail-like bodies of Nemertines; and it is possible that the setæ of Annelids are modifications of them.

The muscular arrangement in *Bipalium*, which is very complex, throws great light on the homologies between the muscular layers of *Turbellaria* and those of other Vermes. In *Bipalium* there is an external circular muscular coat, which even presents the same imbricated structure which is found in it in leeches and other worms. In *Dendrocœlum lacteum* there is also an external circular coat. In cases where a distinct external circular muscular coat is absent, it is represented by a thick membrane, which is very probably contractile. All Turbellarians are built on the same essential type, as regards muscular arrangement, as are other worms. The general muscular arrangements in the bodies of the *Bipalium* and *Rynchodemus* have become much modified from those of flat Planarians by the pinching together and condensation of the body, but they are nevertheless referable to the same type.

The digestive tract consists of three tubes, one anterior, two posterior, as in other Planarians, and as in the embryo leech before the formation of the anus. Characteristic of land Planarians, and consequent on the condensation of the body, is the absence of all diverticulæ from the inner aspects of the two posterior digestive tubes. The close approximation of the intestinal diverticula in *Bipalium* and *Rhynchodemus*, and the reduction of the intervening tissue to a mere membranous septum, is very striking, and seems to foreshadow the condition of things in Annelids. The great difference in the form of the mouth in *Rhynchodemus* and *Bipalium* is also remarkable, considering the many points in which these forms are closely allied.

A pair of large water-vascular trunks, or, as they are here termed, primitive vascular trunks, are conspicuous objects in transverse sections of the bodies of *Bipalium* and *Rhynchodemus*. A peculiar network of connective tissue is characteristic of these vascular canals on section, and is shown to present exactly similar features in *Leptoplana tremellaris*, *Dendrocœlum lacteum*, and *Bothriocephalus latus*. The close agreement in the relative position of the oviducts to the vascular canals in *Dendrocœlum* and our land Planarians is very remarkable. The nerves and ganglia of Planarians lie within the primitive vascular system, as do the corresponding structures within the primitive body-cavity of the leech.

A small marine Planarian was found to contain hæmoglobin. In *Bipalium* there are a series of separate testes disposed in pairs, as in the leech. In *Rhynchodemus* the testicular cavities are more closely packed, and follow no such definite arrangement. The ovaries are simple sacs in both *Bipalium* and *Rhynchodemus*, and are placed very far forwards in the head, a long distance from the uterus. In *Bipalium*, short branches given off from the posterior positions of the oviduct are the rudiments of a ramified ovary, such as exists in *Dendrocœlum lacteum*. The organs described as nervous ganglia by Blanchard in *Polycladus* are almost certainly its testes and ovaries, and therefore the arrangement of these bodies in *Polycladus* is the same as that in *Bipalium*.

The nervous system is ill defined, but appears to consist of a network of fibres without ganglion-cells, which lies within the primitive vascular canals.

Numerous eye-spots are presented in *Bipalium*, most of them being grouped in certain regions in the head, but some few being found all over the upper surface of the body, even down to the tail. In *Rhynchodemus* two eyes only are present. All gradations would appear to exist between the simple unicellular eye-spot of *Bipalium* and the more complex eye of *Leptoplana* or *Geodesmus*, where the lens is split up into a series of rod-like bodies, forming apparently a stage towards the compound eyes of Articulata.

In considering the general anatomy of *Bipalium*, it is impossible to help being struck by the many points of resemblance between this animal and a leech. Mr. Herbert Spencer has, in his "Principles of Biology," placed a gulf between Planarians and leeches by denoting the former as secondary, the latter as tertiary aggregates, so called because consisting of a series of secondary aggregates formed one behind the other by a process of budding. It is obvious, however, that a single leech is directly comparable to a single *Bipalium*. The successive pairs of testes, the position of the intromittent generative organs, the septa of the digestive tract, and most of all, the pair of posterior cæca, are evidently homologous in the two animals. Further, were leeches really tertiary aggregates, the fact would surely come out in their development, or at least some indication of the mode of their genesis would survive in the development of some annelid. Such, however, is not the case. The young worm or leech is at first unsegmented, like a Planarian, and the traces of segmentation appear subsequently in it, just as do the protovertebræ in vertebrates which Mr. Spencer calls secondary aggregates. If Mr. Spencer's hypothesis was correct, we should expect to find at least some Annelid developing its segments in the egg as a series of buds. It is not, of course, here meant to be concluded that Annelids are not sometimes in a condition of tertiary aggregation, as *Nais* certainly is when in a budding condition, but that ordinarily they are secondary and not tertiary aggregates, and if so, then so also are Arthropoda.

"On a new Locality of Amblygonite, and on Montebrasite, a new hydrated Aluminium and Lithium Phosphate." By M. Des Cloizeaux.

Geological Society, Feb. 5, Warington W. Smyth, F.R.S., vice-president, in the chair. The following communication was read:—"On the Oolites of Northamptonshire.—Part II." By Samuel Sharp, F.G.S. In the first part of this memoir the succession of beds in the neighbourhood of Northampton was shown to be as follows:—

	Clay	Great Oolite.
	White Limestone	
	Clay with Ferruginous Band...	
	("Upper Estuarine") ...	
Line of Unconformity.		
Northampton Sand	Sand with Plant Bed...........	Inferior Oolite.
	("Lower Estuarine") ...	
	Variable Beds..................	
	Ironstone Beds	
	Upper Liás Clay.	

The Great Oolite limestone of this section has been confounded, even up to the present time, with a limestone (frequently Oolitic) which occurs between Kettering and Stamford, is prevalent about the latter town, extends through Rutland and Lincolnshire (where it attains a thickness exceeding 200 feet) and into Yorkshire, which limestone has been distinguished by Mr. Judd as the "Lincolnshire limestone." The object of the author was to show that these two limestones were distinct, and that while the former was of the Great Oolite period, the latter as certainly belonged to the Inferior Oolite; and in citing evidence in proof of this position upon stratigraphical and palæontological grounds, he gave a general account of the geology of the northern division of Northamptonshire, illustrating his description by the exhibition of numerous fossils gathered from the various beds and localities referred to. Between Northampton and Kettering, the Great Oolite limestone is the surface rock; and intersecting valleys upon that line, and the escarpment of the Ise valley, a mile east of Kettering, exhibit this sequence of beds:—

Great Oolite	Limestone.	
,, ,, ...	Upper Estuarine Clays.	
Inferior Oolite ...	Lower Estuarine Beds	Northampton Sand.
,, ,, ...	Ferruginous Beds	
Upper Lias.........	Clay.	

And this section, with the successive superaddition of Great Oolite, Clay, Cornbrash, Kelloway Rock, and Oxford Clay, is continued due east across the country to the Valley of the Nene, and on into Huntingdonshire. Upon the same Ise escarpment, about a mile north-east of Kettering, the thin end of the wedge of the Lincolnshire limestone is seen to come in; and this sequence, for the first time, is presented:—

Great Oolite	Limestone.	
,, ,, ...	Upper Estuarine Clays.	
Inferior Oolite ...	LINCOLNSHIRE LIMESTONE (very thin).	
,, ,, ...	Lower Estuarine Beds	Northampton Sand.
,, ,, ...	Ferruginous Beds	
Upper Lias.........	Clay.	

The same sequence, with the occasional superaddition of the Great Oolite Clay, was shown to be repeated upon the western escarpment of the Ise, at Glendon, Barford Bridge, near Rockingham at Weekly, and at Geddington (the Lincolnshire limestone increasing in thickness at every advance), and to occur over and over again upon innumerable escarpments in the counties of Northampton, Rutland, Lincoln, and York, offering unmistakeable and incontrovertible evidence of the true stratigraphical position of the Lincolnshire limestone.

February 21.—Annual General Meeting. His Grace the Duke of Argyll, K.T., F.R.S., president, in the chair. The Secretary read the Reports of the Council, and of the Library and Museum Committee. The general position of the Society was described as satisfactory, and the number of Fellows is said to have essentially increased.

In presenting the Wollaston Gold Medal to Sir Philip de Malpas Grey-Egerton, Bart, F.R.S., F.G.S., the president spoke as follows:—"Sir Philip Egerton,—I consider myself fortunate in being the organ of the Geological Society in presenting you with the Wollaston Medal, which has been awarded to you by the Council for the present year. The eminent services which you have rendered to geology during a period now extending over forty years have long been familiar to scientific men, and have given you more than a European reputation. These services have been so great and so universally recognised, that the only difficulty I now have is not in assigning grounds for the vote which I have the pleasure of announcing, but in explaining why it has been so long delayed. That delay has been occasioned, I believe, solely by the fact that you have yourself been so long an honoured member of the Council whose duty it is to consider the claims of geologists for the honours of this Society; and whatever influence you have had in that body has doubtless been exerted in favour of others to the exclusion of yourself. It is at least some compensation for the loss which the Council sustains in your absence that it is now able to accord a recognition which has long been due. The many papers which you have contributed to this Society from 1833 down to the present time are a sufficient indication of the wide range of your observations. But the special attention you have bestowed, and the light you have thrown on the structure and affinities of fossil fishes and reptiles, have been of the highest value, and have formed in the aggregate a most important contribution to our knowledge of the history of organic life. I have the highest pleasure in now handing to you the Wollaston Medal."

Sir Philip Egerton, in reply, said:—"My Lord President, I know not whether it is owing to the poverty of the English language or to my unskilfulness in use of it, but I am quite at a loss for words adequate to express my appreciation of the great and unexpected honour conferred upon me by the award of the Wollaston Medal, and for appropriate terms to convey to your Grace my acknowledgments of the kind, but too flattering terms you have used in communicating the decision of the Council; and my embarrassment is increased by the consciousness that, in comparison with those illustrious names which already adorn the Wollaston roll, I am quite unworthy of this great distinction. I cannot presume to think that the humble contributions I have been enabled to make to geological knowledge (and indeed to but a limited branch of it) can have been weighed in the balance against the labours of many others on both sides of the Atlantic, whose lives have been devoted to geological research, but who have not yet attained the distinction awarded to me to-day. In comparison with these my claims are quite insignificant. I must therefore look elsewhere to discern the motive which has influenced the Council in selecting my name on the present occasion in preference to others whose scientific claims are far greater than my own, and I think I am right in assigning it to a desire on their part to recognise, encourage, and occasionally reward the labours of those who although their lot in life has been cast in a sphere entailing many paramount duties which ought not to be neglected, nevertheless devote their leisure time to the promotion of scientific research rather than waste it in frivolous and unproductive amusements. In this sense I interpret the mind of the Council in awarding me this medal, and in this sense, as also as a stimulus and incentive to persevere in the cause of that science in which I take so deep an interest, and from the study of which I have derived so much intellectual enjoyment, I can, without arrogance, most gratefully accept it. May I be permitted to add, that if anything could enhance the feelings of gratification I experience in receiving this, the *blue ribbon* of geology, it is that it is presented by a President who, although occupying the highest social rank, and called by our gracious Sovereign to fill the highest offices of State, entailing most onerous duties and grave responsibilities, has nevertheless devoted himself to the study of scientific problems, and has inscribed for himself a name on the tablets of scientific literature, indelible so long as the Reign of Law shall continue to exist."

The President then presented the balance of the proceeds of the Wollaston Donation-Fund to Mr. J. W. Judd, F.G.S., and addressed him as follows:—"Mr. Judd,—I have much pleasure in delivering to you the award of the Council of this Society in recognition of your valuable researches in the Neocomian and Jurassic rocks of England, researches which you are now extending with such marked success to the Secondary and Palæozoic rocks of Scotland. I rejoice to know that you are to carry to an investigation of the West coast of Scotland the experience and knowledge you have shown in your recent account of the Secondary rocks of the East coast. The scattered and broken remains of the Oolites in the Hebrides constitute a most interesting field of investigation; and a detailed examination of them conducted by you cannot fail to cast important light on many geological problems of the highest interest to our science."

Mr. Judd made the following reply:—"My Lord President,—The recollection of an occasion like the present may well be cherished by a student of science as an incentive to exertion second only to the enthusiasm of research itself. Having learned to look to this Society, and never in vain, for the encouragement of sympathy and the guidance of criticism, it is with especial gratification that I receive this mark of confidence at the hands of my teachers and fellow-workers. When I think of the origin and traditions of this bequest—the objects contemplated by its illustrious founder, the distinguished geologists who have been its former recipients, and the important researches to which it has been made contributory—I am deeply impressed by the trust which you have reposed in me. It is my hope that by earnest labour I may be able to testify that my feelings of gratitude are not evanescent, nor my sense of responsibility light, in connection with the great honour which you have this day done me."

The President then presented the Murchison Medal to Mr. William Davies, of the British Museum, and addressed him as follows:—"Mr. Davies,—I have much pleasure in delivering to you the Murchison Medal, which has been awarded to you by the Council of this Society in recognition of the services you have rendered to Palæontology, in the skill and knowledge you have displayed in the reconstruction of extinct forms of life. I have the more pleasure in giving this medal, as I believe you will have the greater pleasure in receiving it, from the fact that it is the first award made under and in fulfilment of the will of the great geologist and excellent man whose loss we have all had so lately to deplore. I trust it may long serve to stimulate others to such services as you have rendered, and which have appeared to the Council of this Society to make you a worthy recipient of the First Murchison Medal."

Mr. Davies in reply said:—"My Lord Duke, I desire to return my most sincere thanks to your Grace as President, and to the Council of this Society, for the honour they have conferred upon me in awarding me the Murchison medal. It is extremely gratifying to find that the humble services I have rendered to Palæontological science have been so kindly appreciated and deemed worthy of this high recognition. The pleasure is greatly enhanced by the fact that I have never considered my scientific work of sufficient importance to deserve any recognition—the acquisition of scientific knowledge and the happiness of communicating it to others having, in my own case, been its own reward. I shall now feel it to be my duty as well as my ambition to render myself more worthy of the distinction you have this day conferred upon me—one which has also an especial significance to a servant of that great National Institution for which Sir Roderick Murchison so long and beneficially acted as a Trustee."

The President then delivered to Prof. Ansted, F.R.S., For. Sec., for transmission to Prof. Oswald Heer, of Zürich, the balance of the Murchison Fund, and spoke as follows:—"Mr. Secretary,—The labours of Prof. Heer in fossil botany and entomology have this year been recognised by this Council in the vote of the Murchison Fund. No branch of Palæontology requires more minute research, more careful comparison, more circumspect conclusions—and there are none, I may add, which, when so conducted, are richer in suggestions on the history of geological change. The fragmentary character which generally belongs to terrestrial and especially to botanical remains, places the study of them under special difficulties, difficulties which have been met with special skill by Prof. Heer. The remains of the Miocene flora are connected with some of the most perplexing problems of our science, and the light which has been thrown upon them by Prof. Heer more than deserves the recognition which I have now the pleasure of delivering into your hands for transmission to that distinguished man. This is the second mark of recognition which this Society has given to Prof. Heer, the Wollaston Donation Fund having been voted to him in 1862."

Prof. Ansted having suggested that Sir Charles Lyell, as a particular friend of Prof. Heer's, might very appropriately speak in his name, Sir Charles Lyell in reply referred briefly to the nature of Prof. Heer's work, and said that he was sure that gentleman would appreciate highly this renewed expression of the interest taken by the Geological Society in his pursuits. Sir Charles Lyell remarked further, that he was particularly gratified that this award had been made at the present time, as Prof. Heer was well advanced in years and in an exceedingly infirm state of health, so that perhaps, another opportunity of showing him respect and sympathy might not occur.

The President then read his Anniversary Address, in which he discussed the phenomena of denudation, referring especially to the influence of subterranean and other movements of the crust of the earth upon the denudation of its surface, and disputing the greatness of the denuding effects of glacial action. The Address was prefaced by biographical notices of deceased Fellows, including Prof. Sedgwick, Dr. Kelaart, Mr. Augustus Smith, Mr. N. Beardmore, and Prof. Pictet.—The Ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—President: the Duke of Argyll, K.T., F.R.S.; Vice-Presidents: Prof. P. Martin Duncan, F.R.S.; R. A. C. Godwin-Austen, F.R.S.; Joseph Prestwich, F.R.S.; Prof. A. C. Ramsay, LL.D., F.R.S. Secretaries: John Evans, F.R.S.; David Forbes, F.R.S. Foreign Secretary: Warington W. Smyth, F.R.S. Treasurer: J. Gwyn Jeffreys, F.R.S. Council: Prof. D. T. Ansted, F.R.S.; the Duke of Argyll; W. Carruthers, F.R.S.; Prof. P. M. Duncan, F.R.S.; Sir. P. de M. G. Egerton, Bart., M.P., F.R.S.; R. Etheridge, F.R.S.; J. Evans, F.R.S.; J. Wickham Flower; D. Forbes, F.R.S.; Capt. Douglas Galton C.B., F.R.S.; R. A. C. Godwin-Austen, F.R.S.; J. Whitaker Hulke, F.R.S.; J. Gwyn Jeffreys, F.R.S.; Sir Charles Lyell, Bart., F.R.S.; C. J. A. Meyer; J. Carrick Moore, F.R.S.; J. Prestwich, F.R.S.; Prof. A. C. Ramsay, F.R.S.; R. H. Scott, F.R.S.; W. W. Smyth, F.R.S.; Prof. J. Tennant, F.C.S.; W. Whitaker; Rev. T. Wiltshire, M.A., F.L.S.

Meteorological Society, Feb. 19.—Dr. J. W. Tripe, president, in the chair. The following papers were read:—"A description of an electrical self-registering Anemometer and rain-gauge," by the Rev. F. W. Stow, M.A. The general principle on which the registering apparatus is constructed is that of the Morse telegraph instrument as worked in America. The tape is drawn by a clock at the uniform rate of 6 inches per hour. As it passes over a grooved brass roller, holes are punched in it by a sharp steel point, drawn down by an electro-magnet whenever the electric circuit is completed, and drawn back by a spiral spring when the contact is broken. There are two grooves in the roller and two electro-magnets, one of which is worked by the anemometer, and the other by the rain-gauge. Thus, when both magnets are in operation, two parallel rows of holes are punched in the tape.—"On the Madras Cyclone of May 2, 1871," by Captain H. Toynbee, F.R.A.S. After giving extracts from several logs containing data taken during the time of the hurricane, and observations taken at the Madras Observatory; the author says it seems fair to conclude that the centre of this cyclone passed to the W. and probably to the N.W. between the parallels of 10° and 13° N.; that its route was probably much interfered with by the high land to the W. and S.W. of Madras; but that it caused very disturbed weather on the west coast of India. The paper concludes with some practical suggestions as to how ships might more safely ride out a gale.—"On the character of the storm of August 21 and 23, 1868, over the British Isles," by Captain T. O. Watson.

PARIS

Academy of Sciences, Feb. 17.—M. de Quatrefages, president, in the chair. A decree of the President of the Republic authorising the election of M. Janssen to the Academy was read, and M. Janssen admitted. M. Faye read the termination of his answer to Fathers Secchi and Tacchini; it was devoted to the refutation of Secchi's statement that spots were solar eruptions and the proof that they were down-rushes caused by cyclones.—M. A. Trecul read a paper on the carpellary theory as regards *Martynia fragrans*.—M. A. de Caligny contributed a further paper on hydraulic engineering, &c.—Colonel H. Levret sent a note on the determination of geographical position on any elipsoid, and M. Boutin a note on the presence of nitre in *Amarantus Blitum;* the dried plant contains 11·68 parts per cent. by weight of potassic nitrate.—M. T. Tissandier presented a description of some meteorological observations made in a balloon.—M. L. Hugo sent a note on two antique dodecahedra in the Louvre, and M. Brachet two microscope lenses made of spinelle ruby; he believes that these will act better than the portion of the object-glass which is usually made of crown glass. A letter from P. Tacchini with a drawing of the remarkable appearance of Jupiter during January was received.—M. J. Bourget sent a paper on the mathematical theory of Pinaud's experiments on the sounds produced by heated tubes.—M. Wurtz presented a note from Dr. L. C. de Coppet on the recent communications of MM. Gernez and Vander Mensbrugghe on super-saturated solutions.—M. Bussy communicated a note from M. Lefranc on atractylic acid; this acid occurs in *Atractylis gummifera* L.—MM. Schützenberger and Risler sent a paper on the oxidising power of blood.—The eighth note of M. P. Bert on experimental researches on the effect of changes of barometric pressure on life, was received.—M. Laboulbène communicated a note on the cause of the elevation of central temperature in cases of acute pleurisy, &c.—M. E. Rivière sent a note on the pre-historic station of Cape Roux.—From M. Champouillon a note on certain imperfections in the official report on recruiting in France was received.—M. Guerin sent a note on silkworm disease; he finds that both healthy and unhealthy moths lay sound eggs.

Feb. 24.—M. de Quatrefages, president, in the chair.—M. Pasteur read a note on M. Cornalia's report on silkworm cultivation. M. Pasteur believes that his system of preserving the healthy eggs will produce good results..—M. Dumas reported on Mr. Fayrer's book on Indian poison snakes.—M. J. Raulin presented a paper on the silkworm disease, and M. Hugo a note on a necklace of polyhedric beads in the Louvre. M. Ed. Weyer a note on left-handed curves of the sixth order. M. de Rebaucour on the cyclic systems, MM. Troost and Hautefeuille on the "solution" of gases in cast and wrought iron and in steel. The authors believe that the gases given off in the "boiling" of iron are due to decompositions in the iron itself.—M. Ch. Violette sent a note on the compound of sugar with potassic chloride, and M. Grimaux one on the solidifying points of solutions of acetic anhydride in water.—M. Bidaud sent a note on the flame reaction of boric anhydride. He finds it to be excessively delicate, with a coal-gas bunsen flame.—M. L. Ranvier sent a paper on the regeneration of cut nerves.—MM. D. Tommasi and G. Quesneville on the action of zinc on acetylic chloride; M. Perry, notes on the third ray in triple refracting crystals and on the variability of the co-efficient of elasticity and dispersion.

DIARY

THURSDAY, MARCH 6.

ROYAL SOCIETY, at 8.30.—On the Vapour Density of Potassium: J. Dewar and W. Dittmarr.—On New Sources of Ethyl and Methyl Aniline: J Spiller.

SOCIETY OF ANTIQUARIES, at 8.30.—On the Troad: Sir John Lubbock.

LINNEAN SOCIETY, at 8.—On the Perigynium of Carex: G. Bentham.

CHEMICAL SOCIETY, at 8.—On the Action of Hydrochloric Acid on Codeine: Dr. C. R A. Wright.—New Process of Mercury Estimation, with some Observations on Mercury Salts: P. Hannay—On a Method of Estimating Nitric Acid: T. E. Thorpe—Note on the Action of Acetates upon Solutions of Plumbic Salts, with Remarks on the Solubility of Plumbic Chloride: F. Field.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

FRIDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—On the Temperature of the Sun and the Work of Sunlight: James Dewar.

GEOLOGISTS' ASSOCIATION, at 8—On the Geology of Brighton: James Howell.—On some Fossils from the Margate Chalk: W. Wetherell.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

SATURDAY, MARCH 8.

ROYAL INSTITUTION, at 3.—On the Philosophy of the Pure Sciences: Prof. W. K. Clifford.

SUNDAY, MARCH 9.

SUNDAY LECTURE SOCIETY, at 4.—The Education of Women: Mrs. Fawcett.

MONDAY, MARCH 10.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

ROYAL GEOGRAPHICAL SOCIETY, at 8 30.—Notes of a Journey in Southern Formosa: J. Thomson.

CANTOR LECTURES, at 8.—On the Energy of Light, with especial reference to the Measurement and Utilisation of it: Rev. Arthur Rigg.

TUESDAY, MARCH 11.

PHOTOGRAPHIC SOCIETY, at 8.—On the Development of Negatives and Transparencies: Col. Stuart Wortley.—On the Photographic Operations for observing the coming Transit of Venus: Lord Lindsay.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, MARCH 12.

SOCIETY OF ARTS, at 8.—On Signalling at Sea, with special reference to Signals of Distress: Capt. Colomb.

GEOLOGICAL SOCIETY, at 8—On the Solfatara and some Sulphur-deposits at Kalamaki, near Corinth: Prof. Ansted.—On the Origin of Clay-ironstone: J. Lucas.—Note in vindication of Leptophlæum rhombicum and Lepidodendron gaspianum: Principal Dawson.—Synopsis of the younger formations of New Zealand: Captain F W. Hutton

ARCHÆOLOGICAL ASSOCIATION, at 8.

LONDON INSTITUTION, at 7.—Fresco and Siliceous Painting: Prof. Barff.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

BOOKS RECEIVED

ENGLISH.—The Student's Manual of Comparative Anatomy and Guide to Dissection, Part 1, Mammalia: G. H. Morrell, M.A—The Romance of Astronomy: R. K. Miller (Macmillan).—Colymbia (Trübner).—A Course of Qualitative Chemical Analysis: W. G. Valentin (Churchill).—Exalted States of the Nervous System. 3rd Edition: R. H. Collyer (Renshaw).—The Story of the Earth and Man: J. W Dawson (Hodder and Stoughton).

FOREIGN.—Einleitung in die Theoretische Physik: V. Von Lang (Williams and Norgate).

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THURSDAY, MARCH 13, 1873

HERBERT SPENCER'S PSYCHOLOGY*

The Principles of Psychology. By Herbert Spencer. Second edition. (Williams and Norgate.)

II.

TO the healthy scientific mind the fine-spun arguments and the wonderful logical achievements of metaphysicians are at once so bewildering and so distasteful that men of science can scarcely be got to listen even to those who would undertake to show that the arguments are but cobwebs, the logic but jingle, and the seeming profundity little more than a jumble of incongruous ideas shrouded in a mist of words. Hence, it is hardly known that one of the two living thinkers who in philosophy stand head and shoulders above all their contemporaries, has put forth all his strength in a grand effort to demonstrate the baselessness, the inconsistency, the unreality of all anti-realistic metaphysics. The disciples of Berkeley and Hume, skilful in argument, and generally armed with a psychology superior to that of their antagonists, have hitherto gained easy victories over the hosts of theologians, who, confident in the truth of their cause, have stood forward, as one might say, unarmed and with naked breast, to fight for the reality of mind and matter. So easily and so invariably have the sceptics and idealists remained masters of the field against all-comers that they have agreed among themselves to regard realism as an exploded superstition "altogether unworthy of the name of philosophy" (Prof. Bain). But the end is not yet. They will have once more to look to their weapons. In Mr. Spencer realism has for the first time found a champion that can do it justice. Nothing behind the acutest idealist in subtlety and force of intellect, he brings to bear on the great metaphysical question of the reality of an external world a psychology as much superior to that of the idealists, as their mental science was superior to that of the divines they so easily vanquished.

Of course we shall not attempt to sketch the argument that occupies nineteen chapters of Mr. Spencer's volume; which has for its groundwork his whole system of psychology, and on the issue of which he considers that his entire philosophy is at stake; for, in his own words, 'should the idealist be right, the doctrine of evolution is a dream." It may, however, not be altogether profitless to dip into this elaborate argument at one or two places. "The argument of the Realist," says Mr. Spencer, "habitually fails from not having as a fulcrum some universally-admitted truth which the Idealist also has to admit." This necessary fulcrum, he alleges, is to be found in the Universal Postulate, which is, that we must accept as true that of which the negation cannot be represented in thought. But, it would almost seem no more easy to obtain universal assent to the doctrine, that the ultimate appeal must be to the inconceivableness of the negation of a proposition, than to establish the truth of realism by argument without the aid of such a fulcrum. At least, Mr. Mill and Mr. Spencer have been battling over this question for twenty years, without coming much nearer agreement than at the beginning. But though they may have done little towards their mutual instruction, many students of philosophy must have profited greatly from what they agree in describing as their "amicable controversy." And in venturing briefly to review the discussion, our justification must be that we do so as a disciple, who studies with reverence the works of both these imperial intellects. We shall first endeavour to outline in as few words as possible what appears to us an important part of Mr. Spencer's argument, leaving his full meaning to become apparent when we proceed to notice some of Mr. Mill's strictures thereon. Propositions, says Mr. Spencer, "are the ultimate components of knowledge. The simplest intuition equally with the most complex rational judgment, has the same fundamental structure: it is the tacit or overt assertion that something is or is not of a certain nature—belongs or does not belong to a certain class—has or has not a certain attribute." "Propositions, then, constitute the common denomination to which all systems of belief, simple or complex, have to be reduced before we can scientifically test them." But propositions are of many kinds; some are relatively simple, some are highly complex. "There are some propositions which tacitly assert little more than they avowedly assert; while there are other propositions in which what is tacitly asserted immensely exceeds in amount what is avowedly asserted." Accordingly, to "compare conclusions with scientific rigour, we must not only resolve arguments into their constituent propositions, but must resolve each complex proposition into the simple propositions composing it." When intelligence is thus resolved into its simplest elements, it is found that there are cognitions of which the terms cannot be separated. Such cognitions we necessarily accept. To ascertain that the predicate of a cognition invariably exists along with its subject, all we can do is to make a deliberate and persistent effort to conceive the negation of the proposition, and having done this, "to assert the inconceivableness of its negation, is at the same time to assert the psychological necessity we are under of thinking it, and to give our logical justification for holding it to be unquestionable." Further, as it is only by the aid of cognitions of this class, and for the trustworthiness of which no higher warrant can be given, that propositions are linked together so as to form what we call proof or disproof, since "logic is simply a systematisation of the process by which we indirectly obtain this warrant for beliefs that do not directly possess it," it must follow that an attempt to invalidate a cognition of this class by a process of reasoning must somewhat resemble the mechanical absurdity of trying to lift the chair on which one sits. Now, the belief that a universe exists apart from and independently of our states of consciousness, is, according to Mr. Spencer, a cognition possessing this quality of highest certainty. When a man looks at a book without speculating, "he feels that the sole content of his consciousness is the book considered as an external reality, . . . he feels that do what he will he cannot reverse this act; . . . while he continues looking at the book, his belief in it as an external reality possesses the highest validity. It has the direct guarantee of the Universal Postulate."

Against this Mr. Mill has argued that the proposed warrant of the truth of propositions cannot be accepted, if for no other reason, because we know as a matter of history that some propositions the negation of which was at one time inconceivable are now known to be false. His examples are—that in sunrise and sunset, it is the sun that moves; that gravitation cannot act through space absolutely void; and that there cannot exist antipodes—men sticking on by their feet to the under side of the earth. For the truth of each of these propositions Mr. Mill thinks that our forefathers had the warrant of what Mr. Spencer calls the Universal Postulate. "To this criticism of Mr. Mill," says Mr. Spencer, referring to the first and last of these propositions, "my reply is that the propositions erroneously accepted because they seemed to withstand the test, were complex propositions to which the test is inapplicable." Unfortunately, in his anxiety to "leave no possibility of misapprehension," Mr. Spencer mentioned, among other things, that we cannot by simple comparison of two states of consciousness know that the square of the hypothenuse of a right-angled triangle equals the sum of the squares of the other two sides. The strange result has been that Mr. Mill has, we cannot help thinking, fallen into a complete misapprehension of his meaning. In the eighth edition of his Logic, Mr. Mill has had the opportunity of replying to Mr. Spencer's argument as it stands in the volume before us. He there says: "It is but just to give Mr. Spencer's doctrine the benefit of the limitation he claims—viz. that it is only applicable to propositions which are assented to on simple inspection, without any intervening media of proof. . . . But in all the three cases which I have just cited (those mentioned), the inconceivability seems to be apprehended directly; no train of argument is needed, as in the case of the square of the hypothenuse, to obtain the verdict of consciousness on the point." We submit that the quality of being "assented to on simple inspection, without any intervening media of proof" is not the distinguishing characteristic of what Mr. Spencer calls a simple proposition. The propositions that can be properly brought to the test of the inconceivableness of their negation are not such as are assented to on simple inspection, but such as "are not further decomposable." Until this misconception on the part of Mr. Mill furnished conclusive evidence to the contrary, we were inclined to think that here, as elsewhere, Mr. Spencer had been needlessly tedious in stating and restating, illustrating and re-illustrating his meaning. That after all Mr. Mill should have so completely missed the true nature of his distinction of propositions into simple and complex is very remarkable. Had not Mr. Spencer declared that the propositions in dispute were examples of what he considered complex propositions? There is no intervening media of proof when we automatically interpret our sensations of sight into such a cognition as —"There is an old man." Yet this is one of the propositions tediously analysed by Mr. Spencer, "to show distinctly the number of propositions included in an ordinary proposition which appears simple. Again, "On a cold winter's night a gas-light seen through the window of a cab, or a light in a shop looked at through a pane that has been much rubbed, is surrounded by a halo. Whoever examines will see that this halo is caused by scratches on the glass, the curves of which are arcs of circles having the light for their centre. The proposition which expresses the result of his observation, and seems to assert no more than the result of his observation, is that on the part of the glass through which he looks the scratches produced by rubbing are arranged concentrically with the light." Included in this apparently simple proposition, however, is this other—"that there does not exist on the same spot scratches otherwise arranged, immeasurably exceeding in number the concentric scratches." The truth is that "the scratches on any part of the glass have no concentric arrangement at all, but run in countless directions with multitudinous curvatures." The propositions in question obviously belong to this class. In the assertion, the sun moves from east to west, there is included the other proposition—the earth does not revolve on its axis from west to east. We scarcely think that Mr. Mill will assert that any human being ever found it impossible to conceive, in Mr. Spencer's sense, that a sphere should so revolve. Thus far, then, we are bound to say that Mr. Spencer's argument remains intact.

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* Continued from p. 300.

With regard to gravitation we cannot do better than quote the note in which Mr. Mill replies to Mr. Spencer on this point:—

> "In one of the three cases, Mr. Spencer, to my no small surprise, thinks that the belief of mankind 'cannot be rightly said to have undergone' the change I allege. Mr. Spencer still thinks we are unable to conceive gravitation acting through empty space. 'If an astronomer vowed that he could conceive gravitative force as exercised through space absolutely void, my private opinion would be that he mistook the nature of conception. Conception implies representation. Here the elements of the representation are the two bodies and an agency by which either effects the other. To conceive this agency is to represent it in some terms derived from our experiences—that is from our sensation. As this agency gives us no sensations, we are obliged (if we try to conceive it) to use symbols idealised from our sensations—imponderable units forming a medium.' If Mr. Spencer means that the action of gravitation gives us no sensations, the assertion is one than which I have not seen, in the writings of philosophers, many more startling. What other sensation do we need than the sensation of one body moving towards another? 'The elements of the representation' are not two bodies and an 'agency,' but two bodies and an effect; viz. the fact of their approaching one another. If we are able to conceive a vacuum, is there any difficulty in conceiving a body falling to the earth through it?"

We are compelled to say that Mr. Mill could not have been much more surprised at Mr. Spencer's statement than we are at his answer. What was it that Newton could not conceive, but which, Mr. Mill says, we have no difficulty in conceiving? Was Newton incapable of forming a mental representation of "one body moving towards another?"—an experience that in common with everybody else, he had hundreds of times every day of his life. No. To put it in plain rough language, he was unable to conceive how one body could move another without in some way pushing or pulling at it. Hence, when he tried to represent in thought the action of the sun upon the earth he found it necessary to imagine a medium—an unbroken line of physical connection between the two bodies. Have we got beyond Newton in this respect? or is it not rather, as Mr. Spencer says, that our scientific men have simply "given up attempting to conceive how gravitation results." Nay, are there not at the present moment some indications that before long scientific men may return to this very problem?

Let us now advance a step. When it is found that we cannot conceive the negation of a proposition—that the subject and predicate cannot be separated in thought; "then, indeed," says Mr. Mill, "the inability to separate the two ideas proves their inseparable conjunction, here and now, in the mind which has failed in the attempt: but this inseparability in thought does not prove a corresponding inseparability in fact; nor even in the thoughts of other people, or of the same person in a possible future." No matter for the present, how we come by our cognitions, this is surely admitting what Mr. Spencer calls the psychological necessity of thinking the proposition. In the next place, we must confess that we have never been able intelligibly to translate into the language of idealism those anti-realistic arguments that appeal to "fact" and to the experiences of "other people." But, whatever may be meant by fact, and whatever may have a place in the minds of other people, it must for ever remain nothing to those in whose consciousness it can be neither presented nor represented. Our science of numbers is not likely to be disturbed because it can be written in words that, perhaps in some inaccessible corner of the universe, or in some mind of a different make from the human, twice two makes five. We have already examined the examples given by Mr. Mill of propositions that have, as he thinks, passed from the condition of being inconceivable to that of being both conceivable and believed, and therefore we do not think it necessary to discuss the probability of any really simple and inconceivable proposition becoming conceivable in the mind of the "same person in a possible future."

We must pass to the next step in the argument as sketched above. Does reasoning rest on the postulate? We cannot help thinking with regret that Mr. Mill has not felt it necessary to put forth his full strength on this point; and we are by no means sure that we have grasped his full meaning. His words are:—"To say that when I apprehend that A is B and that B is C, I cannot conceive that A is not C, is to my mind merely to say that I am compelled to believe that A is C. If to conceive be taken in its proper meaning, viz., to form a mental representation, I may be able to conceive A as not being C. After assenting with full understanding to the Copernican proof that it is the earth, and not the sun, that moves, I not only can conceive, or represent to myself, sunset as a motion of the sun, but almost everyone finds this conception of sunset easier to form than that which they nevertheless know to be the true one." This, as we understand it, seems open to the reply that, had sunset, considered as a motion of the sun, been inconceivable to begin with, no argument would have been needed to disprove it. Having followed the Copernican proof, we cease to believe that the sun moves, we remain, however, still able to conceive its doing so; for though we cannot help believing that of which we cannot conceive the negation, it does not follow that we are unable to conceive the negation of everything that argument has compelled us to believe. But, whether by following a sound argument we are or are not rendered incapable of conceiving the reverse of the conclusion, has, in reality, nothing to do with the question whether reasoning rests or does not rest on the postulate. To invalidate Mr. Spencer's argument by the method he has adopted, Mr. Mill would require to be able to represent in thought, not the sun moving through the heavens, in spite of the Copernican proof to the contrary but that at any step in the argument the conclusion need not follow from the premises. If he could do this he might still be convinced by argument, but we do not see how he must necessarily be so. Mr. Spencer's contention is that reasoning rests on the postulate, not because a valid argument makes the reverse of the conclusion inconceivable, but because the axioms of logic have no higher warrant.

Want of space forbids us entering further into the controversy. For the same reason we are unable to enter upon the inquiry whether we can properly be said to believe that of which we cannot form a mental representation. Mr. Spencer's opinion is that we cannot, and accordingly "that anti-realelistic beliefs have never been held at all. They are but ghosts of beliefs, haunting those mazes of verbal propositions in which metaphysicians habitually lose themselves. Berkeley was not an idealist; he never succeeded in expelling the consciousness of an external reality, as we saw when analysing his language and his reasonings. Hume did not in the least doubt the existence of matter or of mind; he simply persuaded himself that certain arguments ought to make him doubt. Nor was Kant a Kantist: that space and time are nothing more than subjective forms was with him, as it has been and will be with every other, a verbally-intelligible proposition, but a proposition that can never be rendered into thought, and can never therefore be believed."

DOUGLAS A. SPALDING

GEIKIE'S PRIMER OF PHYSICAL GEOGRAPHY

Physical Geography. By Prof. Geikie. Science Primer Series. (Macmillan.)

IT must not be supposed that this is the Physical Geography which we have been expecting from Prof. Geikie. It is a little book of 110 pages, truly a primer, and only makes us more eager to get a larger work.

The primer is written in a vivacious style; the style of a man really interested in what he is talking to his readers about; and in all respects suitably written for its purpose. It would be a little too patronising if it were intended for any but the very young, who like being taken into the confidence of the writer, and spoken to as young friends. It is to be hoped that a larger work may be equally vivacious and vigorous without this characteristic, which is, to repeat, not a fault in the primer, but would be a serious fault in the larger work intended for older boys and readers generally. It is a fault that pervades Kingsley's scientific books: it is a small annoyance at first, but finally "aggravates" one beyond all endurance. Moreover, the book is well illustrated with new, good, and unconventional woodcuts, and is thoroughly well-arranged and printed.

Now for its contents. After its introduction, which is in fact on "eyes and no eyes," we have the shape of the earth, day and night, the air, wind, vapour, dew, mist, rain, snow; the circulation of water on the land, springs, hard and soft water, atmospheric denudation (in shorter words than these), brooks, rivers, snow-fields, glaciers;

then the sea, stratification, coral; and lastly earthquakes and volcanoes.

Now this is just right. Physical Geography ought to contain the dynamics of geology, and not be a mere description of the physical condition of the globe. A description of the plateaus and primary mountain chains, and secondary mountain chains, and plains and river systems of all the countries in the world, and distribution of birds, beasts, and fishes, used to be what was called physical geography: and in it the dynamical element, all idea of change and progress was almost entirely left out. All this description constitutes geographical knowledge, but is of the nature of information pure and simple, and has absolutely no value in education except as an exercise in memory, and as a basis for reasoning, supposing that this reasoning is ever superposed. But what Prof. Geikie gives us is the very life and soul of geological science, observation on what the natural forces around us are doing, information as to what they are doing of the like kind elsewhere, and reasoning on the effect of these forces. It is a book which will at once rouse the curiosity of a child, and train it as far as it goes in sound scientific method.

It is admirably adapted to be a reading book in elementary schools, and it is much to be hoped that it will be largely used. But for this purpose a cheaper edition ought to be published.

J. M. W.

OUR BOOK SHELF

Exalted States of the Nervous System. By R. H. Collyer, M.D. (H. Renshaw.)

IT can only be with a feeling of regret that anyone can see so many pages, nearly 150, occupied with matter and arguments most of which had much better have been retained only among the oral traditions of the author's acquaintances, for by publishing them he lays himself open to the severe criticisms of a non-appreciating scientific public. That Dr. Collyer was among the first to propose and employ anæsthetics, we will not question, but he cannot expect to increase the number of his supporters by the publication of such a work as the above, in which his want of knowledge of the first principles of scientific method and physiological fact is rendered too clear. An instance or two will suffice to indicate the manner in which the subject is treated. Speaking of chloral, he says—"It is administered by the stomach. . . . It seems that the action is immediate on the brain, through the eighth pair of nerves." This is very different from the explanation of the discoverer of that substance, and quite contrary to any explanation of value that has been since proposed. The physiological dogma on which the author bases many of his arguments is that "the lungs at every respiration send vital electricity to the brain, which has been thus assimilated to subserve the purposes of life." In a newspaper account of the relative chances of the Oxford and Cambridge crews for 1871, the author finds sufficient to justify the following valuable generalisation:—"thus endurance *does not belong* to mere size." We think these quotations sufficient.

The Botanists' Pocket-book: containing in a tabulated form the chief characteristics of British plants. By W. R. Hayward. (Bell and Daldy, 1872.)

A BOOK of modest pretensions, and not without its value. As a rule there is no class of scientific literature to be more carefully avoided than that which professes to compress the whole of the elements of a science into a small portable volume; nowhere is the master's hand more urgently required than in the compilation of text-books. Mr. Hayward we do not recollect to have met with before as a botanical writer; this little book, however, evidences great care in its preparation, and the author is careful not to claim for it too high a place. Its object is to "afford information to the tyro, and also to refresh the memory of the more advanced botanist who, by examining on the spot any doubtful plant, may be saved the trouble of carrying home specimens of little value; it is not intended as a book for the study, nor as a rival to the many excellent and complete manuals of our leading botanists; but to be accepted for what it is, viz., 'A Botanist's Pocket-book.'" This purpose it may well serve; occupying not much over 200 pages of thin paper in limp cloth binding, it will be no great burden to the pocket or knapsack, and may frequently be usefully resorted to by a young botanist on the tramp, leaving more careful study till he gets home.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Perception in the Lower Animals

As several persons seem interested in Mr. Wallace's suggestion that animals find their way home by recognising the odour of the places which they have passed whilst shut up, you may perhaps think the following little fact worth giving. Many years ago I was on a mail-coach, and as soon as we came to a public-house, the coachman pulled up for the fraction of a second. He did so when we came to a second public-house, and I then asked him the reason. He pointed to the off-hand wheeler, and said that she had been long completely blind, and she would stop at every place on the road at which she had before stopped. He had found by experience that less time was wasted by pulling up his team than by trying to drive her past the place, for she was contented with a momentary stop. After this I watched her, and it was evident that she knew exactly, before the coachman began to pull up the other horses, every public-house on the road, for she had at some time stopped at all. I think there can be little doubt that this mare recognised all these houses by her sense of smell. With respect to cats, so many cases have been recorded of their returning from a considerable distance to their homes, after having been carried away shut up in baskets, that I can hardly disbelieve them, though these stories are disbelieved by some persons. Now, as far as I have observed, cats do not possess a very acute sense of smell, and they seem to discover their prey by eyesight and by hearing. This leads me to mention another trifling fact: I sent a riding-horse by railway from Kent *viâ* Yarmouth, to Freshwater Bay, in the Isle of Wight. On the first day that I rode eastward, my horse, when I turned to go home, was very unwilling to return towards his stable, and he several times turned round. This led me to make repeated trials, and every time that I slackened the reins, he turned sharply round and began to trot to the eastward by a little north, which was nearly in the direction of his home in Kent. I had ridden this horse daily for several years, and he had never before behaved in this manner. My impression was that he somehow knew the direction whence he had been brought. I should state that the last stage from Yarmouth to Freshwater is almost due south, and along this road he had been ridden by my groom; but he never once showed any wish to return in this direction. I had purchased this horse several years before from a gentleman in my own neighbourhood, who had possessed him for a considerable time. Nevertheless it is possible, though far from probable, that the horse may have been born in the Isle of Wight. Even if we grant to animals a sense of the points of the compass, of which there is no evidence, how can we account, for instance, for the turtles which formerly congregated in multitudes, only at one season of the year, on the shores of the Isle of Ascension, finding their way to that speck of land in the midst of the great Atlantic Ocean?

CHARLES DARWIN

The Sense of Smell in Animals

THE hypothesis put forward by Mr. Wallace in NATURE of the 20th ult., to explain the power possessed by some animals of finding their way back to their homes after having been conveyed from them in such a way as to preclude the possibility of their seeing the road by which they travelled, contains, I think, the solution of a hitherto perplexing problem. To ascribe this power, as is usual, to instinct in the customary sense of the term, is to give what Mr. Bain calls "an illusory explanation of repeating the fact in different language," and it is manifestly impossible to ascribe it to instinct, as that term is understood in the evolution theory of mind. I am glad to see a psychologist like Prof. Robertson giving in his adhesion to Mr. Wallace's view. But while in the main accepting it, and arguing forcibly in its favour, Prof Robertson hesitates to affirm that it affords an explanation of the whole of the facts in question. Is this failure, if failure there be, inherent in the explanation itself, or does it lie in our imperfect knowledge of the facts to be explained? That there are difficulties cannot be denied. For example, it is difficult, to say the least, for the human mind to form the conception of a sense of smell, so acute, so objective, and furnishing sensations so strongly persistent in the ideal, as to enable an animal by its means alone, to retrace unerringly long and devious roads travelled over but once, and under circumstances rendering impossible the co-ordination of sights and smells habitual to the animal. In such cases smell must be a much closer second, if second at all, to sight, than touch is in man. No blindfolded man could perform a like feat by means of unaided touch, nor, do I think, could a blind man, though with the blind this sense becomes, by the cultivation it receives through a hard necessity, greatly more acute than it is in normal cases. But difficulties like these are such, I believe, only because of our very limited acquaintance with the psychology of the lower animals. One of the chief desiderata in mental science is, it seems to me, such a psychology, based upon principles generalised according to strict inductive methods, from a body of numerous, varied, well-authenticated, and scientifically made observations of the domestic and other animals. A work of this kind we have not, but, I believe, the lines upon which it should be constructed are already laid down in Mr. Spencer's truly great work, the "Principles of Psychology." When this branch of psychological science has been brought into something like parallelism with human psychology, difficulties, such as I have hinted at, will, I venture to say, be effectually removed, and Mr. Wallace's explanation will, as he claims for it, "cover all the well-authenticated cases of this kind."

In the extended scope claimed for this hypothesis by Prof. Robertson, viz., as explanatory of the nature of external perception in dogs, there appears to be a difficulty raised. The most refined and deep-penetrating psychological analysis, of both the empiristic and evolution schools, have incontestably established that our mature visual presentations are but symbols of the earlier and really genetic presentations acquired through touch combined with muscular feeling. Granting, as seems undeniable, that smell in dogs holds, in many respects, a place analogous to that of touch in man, would the earliest and the genetic presentations of externality in these animals be those furnished by smell, with or without the aid of muscular feeling?

Before concluding my letter, I should like to offer a remark upon the supposed *experimentum crucis* of Mr. Wallace's hypothesis, suggested by Mr. Bennett. The smell of stale fish would undoubtedly interfere with and overpower ordinary smells in the human organ. But is it not an anthropomorphical fallacy to assume, as Mr. Bennett appears to do, that such would be the result in the case of a cat? From the almost purely subjective and comparatively undeveloped sense of smell possessed by man, there appears to me to be no conclusive argument to the highly objective and extremely acute sense of smell possessed by certain animals. We are not warranted from our own experience in inferring of a sense, quantitatively, if not qualitatively, so very different, that one powerful sensation must necessarily exclude fainter sensations of a like order. Normally, vivid sensations of a particular order do tend to exclude with more or less completeness fainter like sensations. But the animal, in the circumstances in which it is placed, is as Mr. Wallace shows, in an abnormal condition. Its attention is concentrated on the unfamiliar succession of smells it is encountering, and under such a stimulus these ordinarily fainter sensations may not unreasonably be supposed to become unwontedly vivid, and capable of powerfully affecting the animal's consciousness, despite the resistance of what under common circumstances would prove an effectual obstacle to their conscious presentation. A complete *experimentum crucis* would require that the animal should, during the whole journey, be entirely smell-muffled, and Mr. Bennett's expedient could not, I think, be relied upon to produce this effect.

Camberwell, March 3 W. H. Brewer

External Perception in Dogs

The following somewhat remarkable instance of a dog finding its way back was told me by the owner, who lived 20 or 25 miles up (and on the left bank of) the river Canumá, in Brazil; a small river just east of the river Madeira. He took the dog by boat down the river Canumá and up the Madeira to Borba, a small town on the right bank of the latter river; a distance of 70 or 80 miles round; and left the dog there. The dog ran away from Borba and made its way back to its former home on the river Canumá. More exactly, it was making its way back, for my informant being out in the wood some little way inland, and S.W. of his cottage, fell in with it. It was in bad condition, having been some weeks—the exact time could not be ascertained—in working its way back through the forest, and of course had lived by hunting. I cannot give with any exactness the distance overland from Borba: perhaps it is less than 25 miles; and in this respect the return is not remarkable. It seems to me that the dog during its journey by water must have had a constant perception of the bearing of its old home; and on the other hand that it made its way back not by any blind instinct but by trial and error and by recognition of the character of the forest. F. R. G. S.

Sight in Dogs

I think Mr. Kingsley rather underrates the exercise of the organs of vision by the dog when, in comparing it with the horse, he writes,—"The dog, who has smelt everything, but looked at very little." Now it is true that the dog does not look about him when on his travels, in the popular sense, by turning his head about, but close observation shows the eyeball in constant movement, taking in everything in front and on both sides, although, to all appearance, with his head close to the ground, his whole attention is concentrated on the reception of external impressions through his nose. This is particularly noticeable in the terrier, which, on meeting you, however intently he may seem to be engaged in smelling, gives a quick glance at your face without moving his head, or apparently lessening the attention he is paying to something else with his nose. Note, also, how quickly a dog going down wind sees another a long distance off.

The horse not only sees and smells acutely but also frequently touches any object with his upper lip.

In reference to the quotation from "Boswell's Life of Johnson," given by Mr. Nicoll, I may mention that it is well known to huntsmen that horses are very prone to kick if led near the hounds when a fox is being broken up, the explanation always given being that it is the smell of blood which irritates them.

Faringdon, March 9 J. Hopkins Walters

Selenium

Vitreous selenium may be considered a non-conductor of electricity. It is only when in a crystalline condition that it becomes a conductor.

A bar now in my possession, 2·25 × ·5 × ·05 inches, tested with an electromotive force of $\frac{1}{10}$th of a Daniell's cell, gives a deflection of 140 divisions on the scale of an ordinary astatic mirror galvanometer. The same deflection produced under the same conditions through a known resistance, shows the resistance of the selenium to be 360,000 ohms. By the well-known Bridge system the resistance of the same plate of selenium is 359,500 ohms, the two different tests thus confirming each other.

I have to leave this evening for Valentia to report on the electrical condition of the Anglo-American Company's cable, or would write you more fully on the effect of light on the conductibility of selenium.

If selenium be exposed to the direct rays of the sun, it gradually becomes crystalline. May not the explanation of the phenomenon be found in this fact?

All the bars I have experimented upon have been supplied by Mr. H. Bassett, No. 215, Hampstead Road.

Willoughby Smith

Wharf Road, City Road, March 11

Brighton Aquarium

I ADDRESSED a letter some weeks ago to the chairman of the Brighton Aquarium Company, in which, amongst other matters, I suggested that a stand with a few microscopes exhibited therein, which had been offered by a London maker, would be a source of great additional attraction, without being any expense to the company.

I also suggested that it might very likely be the nucleus of a school of marine zoology, if for a separate subscription the directors could set aside a room to be used by students, who might form themselves into a kind of club, and work with their miscroscopes and tanks in quiet. The nearness to London of the Brighton Aquarium might, I remarked, prove the inducement to many non-residents to join; whilst a library, and a few demonstrations, would give increased means of gaining information.

I think, sir, that the importance of my suggestions warrants my requesting you to make them public, since other aquaria might also take the matter up, without damage to the Brighton Company, in the success of which I take the warmest interest.

MARSHALL HALL

New University Club, March 7

General Travelling Notes

I BELIEVE F. G. S. P. would find some of the information he wishes, in a small pamphlet which is to be obtained at the Royal Geographical Society, 1, Savile Row, price 1*s*. There is also an excellent little work (very portable) which has been recently published by some Fellows of the Anthropological Institute for the use of travellers, which would be found useful; price 1*s*.

J. RAE

New Guinea

THE *Academy* for July 15, 1872, contains a note on New Guinea, from *Petermann's Mittheilungen* in which there are two slight mistakes. Perhaps you will allow me to correct them in your journal.

It is said, "The London Missionary Society founded a number of stations on the south-eastern peninsula" in 1871, and that these stations were "in charge of educated natives of the Tongan Archipelago."

The stations founded by the agents of the London Missionary Society in 1871 were not on the large island of New Guinea, but on the small islands of Erub, Tauan, and Saibai in Torres Straits. The Society's vessel has, however, sailed this year with a staff of English and Polynesian missionaries on board, who hope to be able to occupy stations on New Guinea itself.

The "educated natives" placed as pioneers in the first settlements are not "natives of the Tongan Archipelago," but of the Loyalty Islands near to New Caledonia, and they belong to the black Polynesian, or Papuan race. The Tongan Islands are entirely under the care of the Wesleyan Missionary Society.

The missionaries who touched at New Guinea in 1871 believe they saw people similar to the brown Polynesians as well as the black frizzly haired Papuans proper. Hence, evangelists from both races of Polynesians have been sent to New Guinea this year.

S. J. WHITMEE

Samoa, Nov. 6, 1872

Flight of Projectiles

YOUR correspondent, "Robert Reid," asks for an impossibility. There is no impossibility in calculating the theoretical deflection in the flight of a bullet due to a theoretical wind pressure, but the formula could not be "simple." However, Mr. Reid need not be distressed, for it is difficult to conceive any intellectual occupation which would be a more complete waste of ingenuity. Let us consider the real conditions of the problem.

Mr. Reid has not stated them with completeness. It is not sufficient to know the time of flight of the bullet, its size, and weight, the theoretical pressure of the wind, and the angle at which that pressure is exerted. It would be necessary, also, to know the angle at which the rifle is fired, the initial velocity of the bullet, and the space travelled over in its flight. It is obvious at once that the vertical line of flight, if I may be permitted the expression, is not a straight line, but a curve, rapidly accelerating towards the end. If we assume certain arbitrary theoretical figures for initial velocity and strength of wind, there would be no great difficulty in calculating the curve, but it would be a purely imaginary curve, and an utterly useless and deluding calculation. Let us consider the disturbing elements. First, the powder. It would be difficult, if not impossible, to get two charges of precisely and absolutely the same strength. Then the state of foulness would vary. Then the pressure of the wind would always vary in a distance of 500, or 1,000, or 1,500 yards, and in a flight of several seconds; even its very direction would vary at different points in the line of flight, unless in the case of a perfectly open exposed plain.

To all soldiers tempted to indulge in calculations of this nature I would venture to say that there is nothing so likely to mislead. Science and practice should be one and the same thing. If what professes to be science cannot be carried out in practice, it is not true science but bastard science, or pedantry, and the unpractical pedant is even more mischievous in war than the so-called "practical man" in matters of civil life.

Army and Navy Club, March 10 W. HOPE

Glacial Action

IN NATURE of vol. vii. p. 241, you say, "Dr. Dawson thinks that the fiords on coasts, like the deep lateral valleys of mountains, are evidences of the action of waves, rather than that of ice. No glacialist, as far as we know, holds the extravagant belief that fiords have been cut out by ice. They are undoubtedly submerged valleys, and were hollowed out by streams and other atmospheric influences in ages long anterior to the glacial epoch."

A true fiord, like those of Norway, Scotland, and, we may add, the west of Ireland, is nothing but a mountain valley sufficiently depressed for the sea to enter it. I am not a practical geologist, but I have read what appeared to be strong arguments in favour of the belief that the valleys of the Alps have been hollowed out by glaciers. I do not see how any one who sees the quantity of mud that glacier streams bring down, can doubt the great power of glaciers as excavating agents; and the argument is strengthened by the vast moraines, thousands of feet below the present lower limit of the glaciers, and now overgrown with trees, which are to be observed throughout the Alps.

If mountain valleys have not been, in at least a great proportion of cases, excavated by glaciers, how are we to account for the fact that fiords and mountain lakes are almost, if not quite, confined to the higher latitudes? This is especially observable on the west coast of America, which is remarkably unbroken from Vancouver's Island to Chiloe, but broken into fiords from Vancouver's Island northward, and from Chiloe southward.

This observation throws no light on the very different question of the origin of great lowland lakes like those of North America and Africa.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim

The Feeding Habits of the Belted Kingfisher

ON page 48 of Mr. Darwin's "Expression of the Emotions," I find the assertion, "Kingfishers when they catch a fish always beat it until it is killed." We have, in New Jersey, one species of kingfisher, the *Ceryle alcyon*, which is exceedingly abundant for about seven months of the year. For several years I have observed them carefully, both feeding and breeding about the banks of Crossweeksen Creek, and I feel certain that I am correct in saying that I have never seen a kingfisher take its food otherwise than by swallowing it whole, while yet upon the wing. The fish having been swallowed, or at least, having disappeared, the kingfisher will then alight upon the branch of a tree, and will then, frequently, stretch out its neck, and go through a "gulping motion," as though the fish was not entirely in the bird's stomach, or perhaps was only in the æsophagus. In the thousands of instances that I have witnessed, of these birds catching small fish, I never once saw a fish taken from the water, and killed, before being devoured.

So far as my recollection serves me, in the large majority of instances, the kingfisher, after darting into the water and securing a small cyprinoid, will emerge from the stream, uttering its shrill cacophonous scream, as if rejoicing over the delicate morsel it had captured and not scolding at its ill-success, as has been thought; for we have frequently shot them as they rose from the water, and *invariably* found a fish, still alive, in the stomach or œsophagus. Indeed, I cannot see how this characteristic cry of the kingfisher could be accomplished with a fish struggling in its beak. When the fish, from its size or other cause, is retained in the œsophagus until the bird alights, the movements of the bird, to effect the swallowing, are very similar to those of a pigeon while feeding her young. The neck shortens and swells; the feathers are ruffled and the wings slightly open and shut, two or three times.

So far as my observations of the *Ceryle alcyon* extend, Mr. Darwin's remarks will not apply to that kingfisher.

CHAS. C. ABBOTT

Trenton, New Jersey, Jan. 14

A PETRIFIED FOREST IN THE LIBYAN DESERT

ON the western horizon of the Libyan Desert, as viewed from the summit of the Great Pyramid of Ghizeh, a conical hill stands in solitary grandeur, far removed from the route of desert travellers. This has long been supposed to be the ruins of a pyramid, yet nowhere is it recorded to have been visited by any but the Bedouin tribes who pass within a few miles of it, on the old caravan route to the Faioom. It is enumerated by Lepsius as one of the Pyramids of Egypt, and in a recent work on the Great Pyramid* it is called Dr. Leider's Pyramid, "until a better name be found for it," merely from its having been pointed out to the author by the late Dr. Leider of Cairo, who, however, had never visited it.

The following narrative of a visit to the eminence by Mr. Waynman Dixon, engineer, and Dr. Grant of Cairo, and of their discovery of a very remarkable petrified forest near its base, whose gigantic trees lie scattered about the desert in profusion, has been communicated to us by the former gentleman :—

Leaving the pyramids behind and lighted by the clear silvery moonlight, we set out into the desert by the caravan route to the Faioom, leading up a solitary valley, in the rocks of which are cut ancient Egyptian tanks and mummy-pits. Presently we turn off from the regular track and take our way into the unfrequented desert, steering straight westward for the distant pyramidal hill. The sand of the desert is here hard and compact, and travelling easy, indeed, with the exception of one or two places where the sand is soft and heavy, a wheeled carriage might drive all the way, and to most travellers would be much preferable to camel or even donkey riding.

After many hours hard riding, we at last reach the top of a slight eminence, and across the wide valley in front of us is the place of our destination.

These long valleys, or "wadys," have much of interest about them; throughout may be seen the dry water-courses where the rare rain-showers carry down the sand into the bed, and leave all the little hills and eminences covered with flints as big as potatoes and with surfaces so brightly polished as to give the desert a silvery look by moonlight, or by day to cause the appearance of rippled water where they reflect the sunlight. The zoology and botany, too, of the desert are very interesting. There are numbers of the little "jerboa," a species of rat, with long hind legs and long tail with a tuft of hair at its end, which hops about like a kangaroo. Now and then may be seen a gazelle or two scampering off at the unusual sight of a caravan. A few small birds get a precarious existence, and in the sky an eagle or vulture sometimes wings its way. The insects are few, and the herbage is extremely scant, and it is a marvel what the animals live on. There are here and there in the water-courses small tufts of camel-thorn—a little shrub not unlike a whin, another with a coral-like growth, and now and then a handful of a tough wiry sort of grass, but what these again subsist on it is hard to say, for there is not a shower more than once or twice a year, and for nine months there is no dew while the heat of the sand at midday in summer is over 100 degrees.

Arrived at our destination before daybreak, we dismount from our camels, and while the Bedouins are unloading the baggage, we hasten as fast as our legs, stiff with camel riding, will permit, up the heaps of sand and flints to the summit of the so-called Pyramid, to find on attaining it that it is but the conical end of a prism-shaped hill, stretching westward, and standing boldly out of the desert plain.

Near the top the rock crops out, and appears to be a species of friable sandstone fretted by the weather into curious shapes; but the actual summit is covered with flints and sand, and, what strikes one as being very strange, many fragments of petrified wood.

Taking a general survey from this quoin of vantage, we choose the best spot to the north of the hill to pitch our camp, exposed to the slight north wind which blows incessantly here, and descending its steep sides, at the bottom are surprised to find near the chosen spot three large stone trees lying prostrate on the sand. The largest is 51 ft. in length and 3 ft. 6 in. in diameter at its widest end, and 2 ft. at its smallest; they are branching exogenous trees, apparently a species of pine, and the one before us has the fork of a large branch very complete.

Wandering on up the wady to the north of the hill, named by us "Kôm el Khashob"—the hill of wood—we find the whole desert littered with fragments of petrified wood, from twigs the size of one's finger to pieces of large branches or trunks of trees; and on the flank of the hill to the north are hundreds of immense trees, lying half buried in the sand, some 70 ft. long, and in many instances with part of the bark still attached. All of them are exogenous trees—no single instance of a palm could we discover—and from the absence of roots it may be presumed have been drifted here by the sea. The stratum is apparently sandstone, overlying the limestone of the Nile valley; there are also here and there patches of a dark chocolate-coloured friable mineral with specks of green which looked like copper, but proved on subsequent analysis to be carbonate of iron; beds of what the Arabs call "Gyps" or gypsum, and nodules of an intensely hard black granulated looking stone—not unlike emery stone. The whole geological character suggesting the—possibly delusive—suspicion of the existence of coal under the surface.

Having carefully surveyed this neighbourhood we again climbed the "Kôm el Khashob," taking instruments to measure its height and determine its position; the former of which we found to be 752 ft. above the Nile level at Cairo, 602 ft. above the north-east socket of the Great Pyramid, and consequently about 140 ft. higher than its summit.

Having secured one or two sketches of the hill, and the sun being now near setting, we "fold up our tents like the Arabs and silently steal away." Mounting our camels again, and taking a slightly different route on our return, we pass some ancient solitary well-tombs away in the desert, but without mark or hieroglyphic inscription on them. All the way we notice fragments of petrified wood, and near to the pyramids extensive beds of oyster shells. This forest may almost be said to be a continuation—doubtless going much farther westward than we penetrated—of the well-known petrified forest in the Abbasieh Desert to the east of Cairo, which extends a long way in the direction of Suez, but is inferior both in extent and in the size and perfectness of the trees to that of the newly-discovered forest. The formation of the land here would lead to the supposition that it has been the ancient coast line, and that the trees drifted to where they are now found, and were then left in the briny waters of an evaporating sea or salt lake; and as the fibre of the wood decayed slowly away, the space of each cell has been filled up by the crystallising silica held in solution in the water.

Since the discovery of this forest it has been visited by many Europeans in Cairo, and English travellers, and to geologists especially it is well worthy of a visit. It may easily be reached from the Great Pyramid either by donkey, camel, or horse, and is distant under three hours from it—a journey which in the winter may with comfort be accomplished in one day from Cairo. Indeed, if his Highness, the Khedive, who has done so much for the comfort of travellers in making a magnificent road to the pyramids, were to extend it for some half mile farther through the tract of soft sand, carriages could easily drive all the way to the Kôm el Khashob. The locality is now well known to the Pyramid Arabs, and most able and intelligent guides will be found in Ali Dobree, Omar, or others of this Bedouin tribe.

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* "Life and Work at the Great Pyramid," by Prof. Piazzi Smyth, F.R.S.

HUNTERIAN LECTURES BY PROF. FLOWER

LECTURES VII. VIII. IX.

THE family Edentata includes the Bradypodidæ, Dasypodidæ Myrmecophagidæ, Manidæ, and Orycteropodidæ, the first three being from the new world and the last two from the old. Considering them shortly, the Bradypodidæ are leaf-eaters; they have five molars above and four below, no other teeth being present, each tooth is a cylindroid column with a persistent pulp, and is surrounded externally by a harder layer, which causes the free surface to become cupped during wear. There is a peculiar descending process from the incomplete zygoma. The number of the vertebræ is great, their spinous and other processes are but little developed as the back is not much employed in supporting the body. There are extra articular surfaces on the lumbar vertebræ of the three-toed sloth, not found in the two-toed species. The clavicles are sometimes rudimentary, never complete. A bony arch joins the acromial process of the scapula to the coracoid, and the distal end of the clavicle in Bradypus is attached to the latter, a peculiarity which has been explained by Mr. Parker. The supra-spinous notch is converted into a foramen by a bony arch running over it, and there is a supra-condyloid foramen in the humerus of Cholopus only. Considerable rotation of the radius is possible; the hand is peculiarly modified, the fingers being bound together. It is generally stated that the trapezium is anchylosed to the scaphoid, which is very long, but that such is not the case is proved by the examination of the young animal; the trapezium, in fact, anchyloses with the first metacarpal bone. In Cholopus the second and third toes are only present. The ilia are broad, the femur short and with no ligamentum teres; some peculiar small bones are found round the knee. The tibia and fibula are firmly united, but not anchylosed; both genera have three toes on the hind foot. The inner surface of the fibular maleolus sends inwards a conical process, which acts as the pivot in which the externally cupped astragalus is hinged, and thus allows of a great range of movement of the foot. The peculiarities in the number of the cervical vertebræ are well known, no similar abnormalities are found in the fossil genera.

The other Edentata are not purely vegetable feeders; they eat ants and other animal food. In the Dasypodidæ the teeth are numerous, and the cervical vertebræ tend to anchylose together. As in the whole family the sternal ribs are ossified. The degree of development of the carapace is indicated by the size of the vertebral processes, and an extra series of articulations, as in the ant-eater and sloth, occurs in the lumbar region. In Myrmecophaga there are no teeth; the hind feet are quite normal, the front very peculiar, possessing five toes, and claws on the middle three. In the Old World forms, Manis and Orycteropus, there is no extra interlocking of the lumbar region, and in the former no teeth. Orycteropus possesses teeth, each of which may be said to be a compound tooth, each element of which has a persistent pulp.

Hitherto no true sloths have been found fossil in South America; they were then represented by the Gravigrada, which are so termed in contra-distinction to the Tardigrada; they abound in the Pampas of Buenos Ayres, and are found as far north as the United States. *Megatherium* was the first of these large animals discovered, and the original skeleton, obtained in 1789, is now at Madrid. Since then several entire skeletons have been obtained, of which two very fine specimens are to be seen at the Museums of Turin and Milan. Those of the College and of the British Museum are partly from casts. Leidy has placed the North American animal in a distinct species (*M. mirabile*), on account of its geographical distribution, but he is unable to detect any osteological peculiarities, The only teeth in this animal are five molars with persistent pulps above, and four below on each side, as in Bradypus; and they form a continuous series. Each tooth has a double transverse ridge, the hollow of which fits the ridges in the opposite jaw. These ridges do not disappear as the animal gets old, but are permanent on account of the dentine not being uniform in density, the middle being softer than the sides, and therefore wearing away more readily. The teeth in the middle of the series are the largest. The skull is small considering the size of the animal, and the brain-case remarkably so. The brain itself, as known from a cast of the interior of the cranium by Prof. Gervais, closely resembles that of the sloths. The skull is very much elongated, the anterior condyloid foramina being large, it is probable that the tongue was so also. The palate was extremely narrow, and the premaxillary portion extensive. An enormous bony process descended from the zygoma which is also a peculiarity of the other members of the same family. The ramus of the lower jaw was immensely high. In the megatherium only is the molar portion of the mandible of unusual depth, and this is to hold the continually growing teeth. There are seven cervical, sixteen dorsal, three lumbar, five sacral, and eighteen caudal vertebræ; the lumbars, as in Myrmecophaga and Bradypus, possess interlocking processes; the whole column resembles that of the former of those animals more than the latter. The tail was strongly developed, and chevron bones existed on the neural surfaces of the caudal vertebræ. As several scutes were found with the bones of Megatherium, and as the different processes of the vertebræ were strong, it was at one time supposed that this animal possessed a shield, but there is no doubt that the scutes were those of Glyptodon, and the vertebræ do not resemble those of the Armadillo. The sternum was composed of seven pieces, and the clavicles large and well developed, being the only examples of these bones, which are bigger than those of man. As in the sloths, the acromion joined the coracoid, and the supraspinous foramen was strongly bridged over. In its distal limb segments the animal was peculiar. There was no supracondyloid foramen to the humerus; the radius and ulna were free; all the bones of the carpus were represented; the pollex was lost, and the other digits were present; the fourth and fifth metacarpals were elongated, the proximal phalanges very short, and the distal of the index, middle, and ring fingers constructed to carry huge claws, which differed from those of the cats in being flexed instead of extended when they were not in use, upon which depends the difference in the shape of their articular surfaces. The second and third phalanges of the middle finger were anchylosed, and a phalanx was missing in the fifth finger, which did not carry a nail. The pelvis presented the peculiarities of the sloths, and was very large. The femur had a small pit for the insertion of the ligamentum teres. The tibia and fibula were anchylosed at both ends. All the leg bones were massive. The foot was very peculiar, the animal must have rested on its outer edge. The os calcis was very large, with the calcarcaneal process going nearly as far backwards as the toes forwards. The ankle, as in Megalonyx and the other allies of Megatherium, was not pivoted as in the sloths, but the inner maleolus was quite cut away and replaced by a slightly concave articular surface looking downwards and a little inwards, which was continuous with that of the lower ends of the tibia, a ridge intervening. The superior surface of the astragalus was consequently of a peculiar form, possessing a longitudinal median groove. The first and second digits of the foot were missing, and a claw was present only on the third, in which the middle and distal phalanges were anchylosed ; there were two phalanges on the fourth toe, and only one was present on the fifth. As to its habits, there is no doubt that Megatherium was not a burrower as supposed by Pander, nor arboreal as suggested by Lund, but that Prof. Owen's hypothesis is correct in which he considers that it was terrestrial, feeding on trees, which it uprooted or broke boughs off.

Mylodon possessed the same number of teeth as its allies and the sloths, but the anterior pair in the upper jaw were separated by a considerable interval from those behind. All the teeth were more or less cylindrical and had persistent pulps ; the worn surfaces were cupped and not ridged, because the dentine was softest in the centre ; the fourth lower molar was elongated and grooved. Several species of this genus have been found, one only in North America. Gervais has divided off some with more separated anterior molars into a new genus, but Burmeister does not think this justifiable. The College of Surgeons possesses a very good skeleton, almost perfect, obtained in 1841. The skull was very slothlike, the fore part being truncated and the nasal fossae open. There was a large descending process of the zygoma and an ascending one ; the bony arch was complete. There was no enlargement of the molar region in the lower jaw like that of Megatherium. Air cavities existed all round the brain-case, as in the elephant, but to a less degree The vertebræ were C. 7, D. 16, L. 3, S. 7, and Caud. 21. The lumbar vertebræ were anchylosed together to the last dorsal and to the sacrum. The tail was long and powerful ; the limbs much like those of Megatherium, but differed in the radius and ulna being separate, as were the tibia and fibula. In the fore-foot Mylodon had the five digits, with claws on the first three. The ankle was as in Megatherium ; the hallux only was missing, and the fourth and fifth toes did not carry claws.

Scelidotherium was smaller and altogether lighter built than those mentioned above ; the teeth were equidistant and elongated from before backwards as was the head. The rest of the skeleton much resembled Mylodon, but the lumbar vertebræ were not anchylosed.

Megalonyx was a North American form. Prof. Leidy has described it fully. There was a great gap between the anterior tooth, which was large and much like a canine, and the other molars, whose number were the same as in the sloths. The animal had longer and slenderer limbs than those described above and therefore more nearly approached the sloths.

[In last week's report of these lectures, *Thylacoleo* is misprinted *Thylacoles*, and the animal is stated to have 32 instead of 2 molar teeth in the lower jaw.]

FAUNA OF THE NEW ENGLAND COAST

PROF. VERRILL, in discussing the collections made by the parties of the United States Commissioner of Fish and Fisheries upon the Coast Survey steamer *Bache* during her cruise off the coast of New England, in the summer of 1872, sums up by stating that they represent six distinct faunas and sub-faunas as follows :—

(1) The surface fauna outside of the banks, and, at certain times, even extending over their outer slopes. This is essentially the same as the fauna prevailing over the entire surface of the central parts of the Atlantic Ocean, and shows very clearly the direct effects of the Gulf Stream.

(2) The surface fauna inside of the Banks, which is decidedly northern in character, very similar to that of the Bay of Fundy. The contrast between the two shows that the Gulf Stream is almost entirely turned aside by the Banks, and has comparatively little effect upon the fauna between them and the coast.

(3) The fauna of the St. George's Bank itself. This is decidedly boreal in character, and essentially identical with that of the Bay of Fundy at corresponding depths, on similar bottoms, and in regions swept by strong currents. The fauna of the south-western part, however, is less boreal than that of the north-western.

(4) The fauna of the Le Have Banks, and off Halifax. This, even at the moderate depth of twenty fathoms, is decidedly more arctic in character than that of the St. George's or the Bay of Fundy at similar or even greater depths.

(5) Between the St. George's and Le Have Banks and the coast there is a great region of cold and comparatively deep water—in places more than 100 fathoms in depth—with a bottom of mud and fine sand, and communicating with the great ocean-basin by a channel between the St. George's and Le Have banks, which is comparatively narrow and, in some places, at least 150 fathoms deep. This partially inclosed region has, physically and zoologically, the essential features of a gulf, and may be called the St. George's Gulf. The deeper waters of the Bay of Fundy are directly continuous with those of this area. The fauna of this Gulf and of its outlet is peculiarly rich in species new to the American coast, and nearly identical with that of the deeper waters of the Gulf of St. Lawrence, and agrees very closely with that found on muddy bottoms, and at similar depths, on the coasts of Greenland, Finmark, and Norway.

He also presents additional generalisations as follows :—

(6) The deepest dredging, in 430 fathoms, was outside of the St. George's Banks, on the slope of the actual continental border, and within the limits of the true Atlantic "basin." The fauna there is especially rich and varied, decidedly northern in character, and agrees closely with that of similar localities and depths on the European side. The animals were mostly such as inhabit bottoms swept by strong currents in the Bay of Fundy.

(7) Everywhere over the banks, and especially on the southern slopes, the difference between the bottom and surface amounts to from 15° to 20°, or even more ; the surface temperature being usually from 60° to 72°. The temperature of the air was very near that of the water, generally one or two degrees higher.

(8) No such contrast of temperature was found inside ot the Banks in the St. George's Gulf or the Bay of Fundy ; the difference seldom being more than ten degrees, and often, especially in the Bay of Fundy, less than five. The surface temperature at corresponding dates in the Bay of Fundy were 48° to 53°, showing an average difference of about 20° for the surface temperature in the two regions, while the average bottom temperatures do not appear to differ materially.

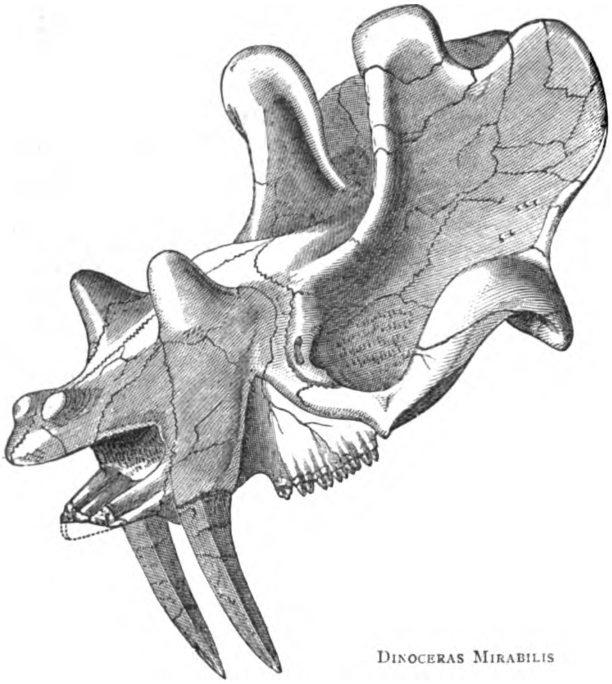
(9) The high surface temperature of the Banks is evidently due chiefly to the direct influence of the Gulf Stream.

(10) The very low surface temperature of the Bay of Fundy is largely due to its *geographical position*, and the *absence* of any appreciable influence from the Gulf Stream, but it is no doubt intensified by the powerful tides, which are constantly mixing the cold bottom water with that of the surface.

The facts hitherto observed do not seem to warrant the assumption that an "arctic current," properly so-called, as distinguished from the tidal currents, enters the St. George's Gulf or the Bay of Fundy. The action of the tidal currents in bringing up the cold bottom waters of the ocean is perhaps a cause sufficient to produce most of the coldness of the water in this region.

ON DINOCERAS MIRABILIS (MARSH)

A SHORT time ago we gave a note respecting one of the recently-discovered gigantic fossil mammals from the Eocene of Wyoming in the region of the Rocky Mountains; the accompanying woodcut, copied from a paper by Prof. Marsh, on this extraordinary extinct animal, named by him *Dinoceras mirabilis*, will further assist in making its peculiarities easily understood.



Dinoceras Mirabilis

The animal must have been nearly as large as the elephant, to which its limb-bones were very similar. The only teeth it possessed in the upper jaw, were a pair of well-developed canine tusks, and six pairs of small molars, whose crowns were formed of two transverse ridges, separated externally, but meeting at their inner extremities. The frontal region of the skull was concave, on account of the lateral projection upwards of a bony ridge or crest on each side, which posteriorly developed into a large osseous process that may have been a horn core but perhaps was only covered with thick skin, and acted like the fibrous pads on the cheeks of the wart-hog, to shield the thinner skull from direct blows. Behind these the crest extended back beyond the level of the occipital condyles. The maxillaries each bore a conical process, which in a profile view is evidently seen to be directly above the root of the canine tusk, and supported it; it probably carried a horn. At the anterior extremities of the nasals were also two smaller horn cores. The horns must have been of a character very different from those in the rhinoceros, in which animal, however long they may be, they are only supported on a roughened surface of bone; if they resembled those of the cavicorn ungulata, from analogy we must suppose that they were small, for in those animals there is a close relation between the size of the core and that of the horn which it carried.

There were no postorbital processes to the frontal bones. The zygoma was completed in front by the malar, the lachrymal was large, and formed the anterior border of the orbit; its foramen was exserted. The infraorbital foramen must have been behind the zygomatic ridge, as it does not appear in any of the drawings. The premaxillaries did not carry teeth; they sent forward two branches, which partially enclosed the sides of the external nares; the upper branch joined the nasal, and the lower, as in the Ruminants, continued free, and probably carried a pad. Prof. Marsh gives no illustration of the mandible, and only remarks of it that "the lower jaw was slender and the tusks small." The limbs were short, the fore limbs shorter than those behind. The radius did not cross the ulna so obliquely as in the elephant. In the head of the femur there was not any pit for the insertion of the round ligament. The great trochanter was flattened and recurved; the third trochanter was absent. The tail was short and slender. The ribs had rudimentary uncinate processes.

Prof. Marsh feels justified in placing Dinoceras in an order Dinocerata, distinct from the Proboscidia, on account of the absence of upper incisors; the presence of canines and horns; the absence of large cranial air cavities; the malar forming the anterior portion of the zygoma; the absence of a proboscis, which could not have been necessary in an animal that could easily touch the ground with its nose, and other less important differences.

This *Dinoceras* of Marsh is the *Eobasileus* of Cope and the *Uintatherium* of Leidy. The shortness of the published descriptions prevents us saying more about it at present.

THE TROGLODYTES OF THE VEZERE *

III.

Our Troglodytes of the latest epoch had, in fishing, another resource unknown to their predecessors. Their different stations contain a large number of fish bones; but it is remarkable that all these fish were salmon. Now the salmon in these days neither frequent the Vézère nor the part of Dordogne where that river joins the sea. At some leagues below the confluence, not far from Lalinde, in the centre of Dordogne, there is a bank of rocks, which, at high water, forms a rapid, and at low water a regular fall, called, The Leap of the Gratusse. The salmon do not pass this boundary, and, as it did not stop them at the epoch of the Troglodytes, we must conclude that, since that time, the level of the Dordogne has fallen, either by hollowing out its bed so as to lay bare the bank of rocks, or by losing part of its volume of water. We are led to believe that the fishermen of that time did not use nets, for with a net could be caught fish of all sizes. We thus understand why they could only catch large fish, and why they chose, among these, the kind they preferred. Had they any fishing boats? We have as yet found no proof of such. And besides, the Vézère is sufficiently enclosed for the large fish to swim along the banks within reach of the harpoons.

The harpoon of our Troglodytes was a small dart of deer-horn, very similar to the large barbed arrows, except that it was only barbed on one side. A little notch at the base enabled the fisherman to secure the cord which he held in his hand (see above, Fig. 10). The barbs are intended to secure the fish which it has struck. Why are these barbs all placed on the same side? Is it to diminish the width of the dart and make it more penetrating? This I cannot venture to affirm.†

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* Continued from p. 325.

† One of my colleagues of the French Association, M. Lecoq de Boisbeaudrau, who did me the honour of being present at this lecture, communicated, the following day, to the Section of Anthropology, a very interesting note on the mode of action of the unilateral barbs of the harpoon. While the harpoon is traversing the air, these barbs cannot make it deviate sensibly; but directly it enters the water, the unequal resistance it meets there must necessarily change its direction. It seems, then, that the fisherman who aims straight ought the most frequently to miss his aim. But M. Lecoq de Boisbeaudrau reminds us of the well-known experiment of the straight

After fishing and hunting, they returned to the cave for their meals.

In the whole extent of the floor of the caves, at every level, the stratum which encloses broken bones contains likewise an enormous amount of particles of coal. This mixture is so universal, so uniform, that it is difficult to believe that the Troglodytes only made fires for warming themselves. They must have lit their fires every day, and in all seasons; and hence it is more probable that they used them for cooking their food.

We do not know how they produced fire, whether they drew it from flint or from wood heated from friction.

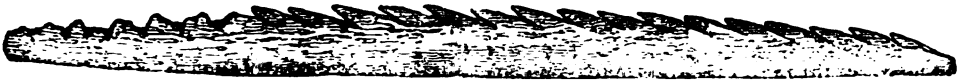

FIG. 13.—Bone harpoon of the Terra del Fuegans.

Neither do we know how they cooked their food. They had no earthenware, and could not boil their meat on the fire. They did not roast it, for hardly a solitary calcined bone has been found, and then it has evidently been accidentally reduced to this state. Perhaps they boiled it in wooden vessels, in which water can be brought to the boiling point by putting into it pebbles made red hot in the fire. But it seems to me more probable that they cooked it under the ashes, as many uncivilised nations do to this day.

They enjoyed the brains of animals and the marrow in the long bones, for all the heads are broken, and all the medullary bones (to the exclusion of all others) are methodically divided. The marrow in bones is a dish relished by all savage nations. They break the long bone in a particular manner, and the chief sucks the marrow first. Our Troglodytes had little flint maçes with cuneiform edge; these were a kind of hatchet for breaking the bones. There is, besides, another utensil in deer-horn, which was probably used for extracting the marrow (Fig. 14)

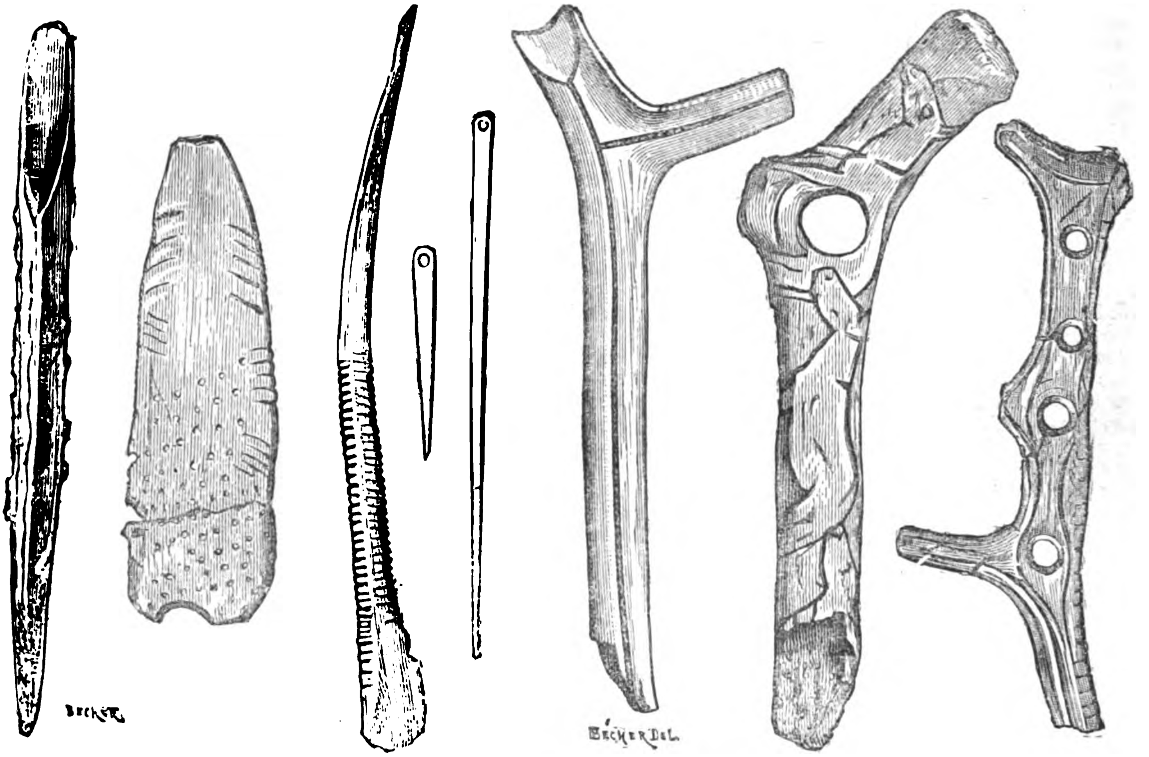

FIG. 14. FIG. 18. FIG. 17. FIGS. 15, 16. FIG. 21. FIG. 19. FIG. 20.

Fig. 14—The marrow spoon. Figs. 15 and 16.—Needles. Fig. 17.—Hunting tablet. Fig. 13.—Account tablet. Fig. 19.—Baton of command with a single hole (reduced a third). Fig. 20.—Baton of command with four holes (reduced a third). Fig. 21.—The pogamagan of the Esquimaux (reduced a fourth).

The Troglodytes, after their meals, left the bones spread about the floors of their caves. In a warm climate, these remnants would have exhaled an insufferable odour, but we must not forget that the temperature was then lower than it is now, and we must likewise confess that cleanliness was not the predominant feature of the men of those days.

Thanks to this uncleanly habit, the floor of their caves furnishes us with complete information as to their food. The flesh of the reindeer was their principal nourishment; they ate besides horses, aurochs, several kinds of oxen, chamois, wild goats, and even some carnivora; their predecessors did the same; but these had fish in addition, and the improvement in their bows and arrows enabled them to bring down game on the wing. Among

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stick which appears broken when plunged obliquely in the water. In consequence of the refraction of the rays of light, the image of the fish is displaced, and in aiming straight at that image, one would miss one's aim. Here, then, are two causes of error. Now it is clear that, if they act inversely, they may compensate each other; and M. Lecoq de Boisbeaudrau demonstrates that when the unilateral barb is turned upwards, it brings back the harpoon towards the object. This arrangement in the harpoon would then be intended to rectify the aim, and this would credit our Troglodytes with a great power of observation.

The inhabitants of Terra del Fuego still use a harpoon with unilateral barbs (see Fig. 13).

the remains of their repasts are found a variety of birds.

Among these innumerable *debris* of bones, there is not a single fragment of a human bone. Our good Troglodytes were, therefore, not anthropophagi. They must have fought occasionally to defend or enlarge their hunting territory; nevertheless, their equipment was more that of huntsmen than of warriors.

In reviewing their panoply, it is evident that the most dangerous weapons, those which could be available in a hand-to-hand fight, are the most rare, and we remain convinced that they were a pacific race.

It might be concluded that they wore no clothing, because all the men represented by their artists are completely naked; but that proves absolutely nothing. Do we not know that the Greeks often represented their gods and their heroes in a state of nudity?

In the Troglodyte caves have been found all the requisites for needlework. They had needles of bone and of deer-horn. Some were only piercers, like a shoemaker's awl, others were provided with an eye for holding the thread (see Figs. 15 and 16). There were some very fine ones. A small needle case has been found, made of a bird's bone, which could contain a number of them. They are supposed to have been obtained from the metacarpus of a horse, on which several longitudinal and parallel incisions, with a fine saw, have extracted little, narrow, even spiculæ of long bones. The work was not complete; but it is evident that these slender spiculæ could only be destined for making needles. The threads used in sewing were doubtless of different kinds. Did they use vegetable fibre or fine lashes of leather? It is possible and even probable. What is nearly certain is that our Troglodytes made threads or at least strings with the substance of tendons.

I do not know whether the Troglodytes utilised thus the nerves of the reindeer, but they carefully detached the long tendons with a certain little blow which produced on the surface of the bone a superficial abrasion of a very regular shape. This abrasion, always the same, has been found on different bones, but the spots where it exists have this in common, that they mark the place of a long tendon. It is, therefore, the proof of a methodical operation, which was doubtless practised before giving the meat to the cook, and which was probably destined to prepare threads for sewing.

Sewing is a proof of clothing, and not of that primitive clothing which consists of the skin of some animal thrown over the shoulders, but of a more complete dress, formed by the joining of several skins. The abundance of needles and piercers, and of scrapers which helped to prepare the skins, proves that the use of clothing must have been general. They also wore ornaments, which perhaps served as marks of distinction. These were necklaces or bracelets, formed of shells perforated and threaded.

Most savage nations have the habit of painting and tattooing themselves; we have no right to despise them on this account, for tattooing is still held in honour in the popular classes of the most civilised countries, and it is even hinted that ladies in the upper circles have not quite forgotten the art of pencilling. We must not then wonder at finding similar fashions among the Troglodytes. Their caves contain numerous fragments of the red stone which we call *red ochre*; the stripes frequently found on these fragments prove that they have been scraped. They therefore prepared a red colour, which was in constant use, and which probably served to ornament the body with pictures.

I have already said that Troglodytes were not nomads. Some individuals may doubtless have undertaken voyages, but the entire tribe never went far from their caves. It was then by means of barter or commerce that certain foreign articles were imported. The numerous perforated shells of which the necklaces and bracelets were composed, were all foreign to the locality. Most of them belonged to the species *Littorina littorea*, and came from the shores of the Atlantic, where they are still very abundant. They were brought quite fresh, for they had their natural colours, which are preserved to this day in the floors of the caves. Other shells pierced in like manner with one hole, belong to five extinct species only to be found in *faluns*, and which date from the Miocene epoch. They are quite discoloured and broken into molecules; and the traces of rolling which they sometimes present, prove that they were fossils long before they were extracted from their tertiary beds to ornament man. Now the *faluns* which contain these five species are not found in the region of the Vézère. The nearest are those of Touraine, and it was from thence, in all probability, that our Troglodytes imported this toilet necessary. There have been likewise found in three stations, and principally at Upper Laugerie, little pieces of rock crystal; this substance must have come from the Pyrenees, the Alps, or the mountains of Auvergne. The foreign relations of the Troglodytes were therefore rather extensive.

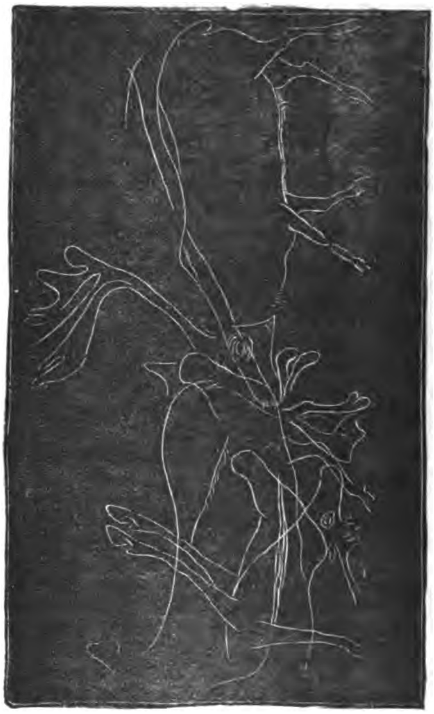
FIG. 22.—Combat of Reindeer.

Had they any religious faith? Nothing has been found in their habitations which could refer to any religious worship. But they wore talismans or amulets. These were a canine or incisive tooth of wolf, reindeer, ox, or horse. A hole, carefully bored at one extremity of the tooth, served for passing the string by which it was suspended.

At the same epoch, but in a different spot, certain funereal rites were observed. They placed the dead in a cave, whose narrow opening was closed by a flag-stone. In front of this stone was a little esplanade on which the afflicted relatives consoled themselves with feasting. This kind of consolation has been perpetuated from age to age, and it has not yet disappeared from among us.

At present we know of but one burying ground of the Troglodytes of the Vézère; it is that of Cromagnon. It is under a shelter and not in a cave; by the side of the corpses were placed carved flints and ornaments in shells, but there is no trace of a stone door.

The society of the Troglodytes was numerous, and hierarchically organised. There were several orders of dignitaries. The proofs of this organisation are to be found in the three stations of the last epoch—the Eyzies, Lower Laugerie, and the Madelaine. They are large pieces of deer-horn, carved artistically, and designated in general terms under the name of "batons of command." These batons are numerous. Here are several, and you can see that they have a uniform type. Their whole surface is richly adorned with various drawings, representing animals or hunting scenes. They are less thick than wide, and the care that has been taken to diminish the thickness proves that they sought lightness rather than solidity. Then, again, the greater number, though not all, are pierced with large round holes, varying in number from one to four (see Figs. 19 and 20). The purpose of these very curious objects is still a disputed point, but most probably they were used as insignia. They indicate the sceptre, borne among the ancients, not only by the king, but by the chiefs of a less elevated rank. The dignity of marshal is to this day characterised by a baton. The batons of command are too numerous to allow of their being considered a sign of royalty. They are only signs of hierarchical distinction. The holes indicate the grade.

This superposition of grades or ranks, a sure sign of a numerous society, might doubtless be utilised in times of war, but it is very probable that it referred primarily to the appointment of hunting expeditions, for the chase was the essential element of public prosperity, and it was necessary to organise it systematically in order to secure food for the community.

Thanks to the organisation and administration of which we recognise the proofs, the society of Troglodytes, though numerous, lived in comfort. Food was sufficiently abundant to enable them to choose the best pieces, and reject those of an inferior quality. Thus, they despised the feet of animals, which nevertheless contain, in the bones and tendons, a remarkable quantity of alimentary matter. The destruction of dangerous animals had given security; the improvement in hunting had given abundance. It was no longer necessary for the entire tribe to devote their whole time, energy, and intelligence to the urgent necessities of daily life. They could rest occasionally. They could have leisure hours, and leisure, joined to intelligence, produces the arts.

(*To be continued.*)

NOTES

THE names of fifty-three candidates which, in pursuance of the Statute, were read out at the meeting on Thursday last, is a proof that the desire to enter the Royal Society does not abate. Out of this large number the Council will, in April, select fifteen whom they will recommend for election; and the names of these will, as usual, be made known at the meeting of the Society on the first Thursday in May. The selection ought not to be difficult, notwithstanding that in perusing the names we mark not a few instances of misplaced ambition, and indications that an obvious misunderstanding as to the qualification for membership exists on the part of the candidates. It must not be forgotten that the Royal Society is *not* a kind of superior College of Surgeons or Physicians or Preceptors; in fact, that something higher even than the art of healing or teaching must be looked for, namely, research, and the enlargement of the boundaries of knowledge. As in the majority of cases non-election is inevitable, it is as well that the number should be large: disappointment is, thereby, reduced to a minimum. But here is the list, and our readers may judge for themselves. The election day is fixed for June 12. W. Aitken, M.D.; Sir Alexander Armstrong, K.C.B., M.D.; R. Stawell Ball, LL.D.; Rev. A. Barry, D.D., D.C.L.; E. Middleton Barry, R.A.; J. Beddoe, B.A., M.D.; I. Lowthian Bell; G. Bishop, F.R.A.S.; F. J. Bramwell, C.E.; W. Lawry Buller, Sc.D.; Capt. E. Kilwick Calver, R.N.; A. Carte, M.A., M.D.; W. Chimmo, Commander R.N.; H. Davies, M.D.; Henry Dircks; R. L. J. Ellery, F.R.A.S.; J. Fayrer, M.D.; P. Le Neve Foster M.A.; T. Minchin Goodeve, M.A.; L. D. Brodie Gordon, C.E.; Lt.-Col. J. A. Grant, C.B.; J. Eliot Howard; Rev. A. Hume, LL.D.; Edmund C. Johnson, F.R.C.S.; Lord Lindsay, F.R.A.S.; Clements R. Markham, C.B.; W. Mayes, Staff-Commander R.N.; E. J. Mills, D.Sc.; R. Stirling Newall, F.R.A.S.; G. E. Paget, M.D., D.C.L.; F. Polkinghorne Pascoe, F.L.S.; O. Pemberton, M.R.C.S.; Rev. S. J. Perry; J. A. Phillips, F.G.S.; W. O. Priestley, M.D.; C. B. Radcliffe, M.D.; A. Rattray, M.D., R.N.; E. J. Reed, C.B.; W. Chandler Roberts, F.C.S.; G. W. Royston-Pigott, M.A., M.D.; W. Westcott Rundell; Osbert Salvin, M.A.; Major-General H. Y. Darracott Scott, R.E., C.B.; J. Spiller, F.C.S.; Hon. J. W. Strutt; G. J. Symons, F.M.S.; Sir Henry Thompson, F.R.C.S.; E. T. Truman, M.R.C.S.; F. H. Wenham; Capt. C. W. Wilson, R.N.; H. Woodward, F.G.S.; Lieut.-Col. A. H. P. Stuart Wortley; J. Young, F.C.S.

M. BERTHELOT, the eminent chemist, has been elected a member of the French Academy.

THE reports of the Hunterian Lectures which appear in NATURE are not written by Prof. Flower.

THE Belgian Academy announces the following as subjects for prizes to be awarded in 1874:—1. To perfect in some important point, either in its principles or its applications, the theory of the functions of an imaginary variable. 2. A complete discussion of the temperature of space, based upon experiments, observations, and the calculus, stating the grounds for the choice made between the various temperatures which have been attributed to it. 3. A complete study, theoretic and, if necessary, experimental of the specific absolute heat of simple and compound bodies. 4. New experiments upon uric acid and its derivatives, principally in relation to their chemical structure and their synthesis. 5. (*a.*) A succinct critical *résumé* of existing observations of the *Mucedineæ*. (*b.*) The exact determination—applied to only a single species—of the part which is due, first, to the essential nature of the vegetable (its specific energy), and next to the external conditions of its development. (*c.*) A positive proof, or a satisfactory disproof, of the statement that the fungi of fermentation in certain circumstances, can be transformed into fungi of a higher class. 6. A paper on the Plutonic rocks, or those that are considered such, of Belgium and the French Ardennes, especially in relation to their composition. The prizes for Nos. 1, 4, and 5 will be a gold medal of the value of 600 francs; for No. 6, one of the value of 800 francs; and for No. 3, a medal worth 1,000 francs. The manuscripts, which may be in either French, Flemish, or Latin, must be sent to M. Ad. Quetelet, perpetual secretary, before August 1, 1874.

WE understand that Mr. F. J. M. Page, B.Sc., Assoc. R.S.M., F.C.S., has been appointed chemical assistant to the Brown Institution, under Dr. Burdon Sanderson. It is with much pleasure that we announce this, as it argues well for the attention which will be paid to physiological chemistry, a subject which of late years has received comparatively little attention in England.

AN examination for a Natural Science Scholarship for 60*l.* per annum will be held at Gonville and Caius College, Cambridge, on April 3 and 4. The subjects:—chemistry and experimental physics, zoology with comparative anatomy and physiology, botany with vegetable anatomy and physiology. The Scholarship is tenable for two years, but the tenure may be prolonged for another year if the Scholar sufficiently distinguish himself in the annual College examinations. No person will be eligible who has commenced residence in the University, and the successful candidate will be required to enter his name at the College forthwith, and begin residence in October next. For further particulars apply to Dr. Drosier, Gonville and Caius College.

WE have received from the Science and Art Department a thick pamphlet containing the prospectus of Sir Joseph Whitworth's Scholarships for mechanical science. These Scholarships are of the value of 100*l.* a year, and are tenable for three years, and the competition is open to all Her Majesty's subjects, at home, in India, and in the Colonies, who have not completed their 26th year, though we see that after the next examination (May 1873) the limit of age will be 22 years. Ten Scholarships will be competed for this year, at examinations which will be partly in practical workmanship, and partly in theoretical subjects. Those who desire detailed information, should procure a copy of the very full prospectus.

THE examiners for the Burdett-Coutts Scholarship, Prof. Phillips, Prof. Odling, and Mr. E. Chapman, M.A., have recommended to the trustees for election, Mr. Edward Cleminshaw, Postmaster of Merton College. The Scholarship was founded by Miss Burdett Coutts for the promotion of the study of geology and of natural science as bearing on geology. The Scholarship is tenable for two years. Mr. Cleminshaw was placed in the first class by the examiners in the Natural Science School in December last. He received his Scientific training in the Applied Sciences department of King's College, London.

MR. J. J. TAYLOR, of Giggleswick Grammar School, has been elected to the Junior Studentship in Natural Science at Christ Church, Oxford. This studentship is of the annual value of 100*l.* Mr. Taylor's scientific training has been under the direction of Dr. W. Marshall Watts, the Science Master of the School.

WE understand that Mr. Osbert Salvin, F.Z.S., is about to return to his old collecting quarters in Guatemala for a short period. Mr. Salvin's valuable contributions to the fauna and flora of Central America are well known, but we trust that he will still be able to add to his former discoveries, extensive as they have already been.

THE Russian Government has determined to send a scientific expedition with the military force to Khiva. It will leave in the course of the present month.

WE have received a copy of the syllabus of a course of lectures on botany to be delivered in the Royal College of Science, Stephen's Green, Dublin, by Prof. W. R. McNab. It differs from most other similar courses of lectures in its arrangement, being closely modelled after Sachs's "Lehrbuch." Commencing at once with the morphology of the cell, it proceeds then to the morphology of tissues and the external morphology of plants; then to the special morphology of the various groups of Thallophytes, Characeæ, Muscineæ, Vascular Cryptogams, and Phanerogams; and finally to physiology. Though, perhaps, erring on the side of two great minuteness for a short course of lectures, it is admirable in its comprehensiveness and scientific arrangement.

DR. DAVID MOORE, the Director of the Botanic Garden of the Royal Dublin Society at Glasnevin, has made a successful attempt to propagate the well-known parasite of the South of Europe, *Loranthus europæus*, on oak-trees in the gardens. This has frequently been attempted previously by horticulturists in this country and in Ireland, and Dr. Moore deserves great credit for the energy and perseverance with which he has carried his efforts to a successful issue. The common mistletoe, which is not a native of Ireland, has also been successfully introduced by Dr. Moore and others into that country, and is now rapidly spreading; and in the Botanic Gardens *Lathræa squamaria* and two species of *Orobanche* have also been permanently established, and six species of *Cuscuta* or dodder more transitorily.

Two fine plants, both from Moreton Bay, are at present objects of interest at Kew. The tree of *Araucaria Bidwilli*, in the temperate house, has produced cones for the first time in Europe. It was one of the two original plants brought to this country in 1842 by Mr. Bidwill, the other having been purchased for 100 guineas by the Duke of Northumberland. The Kew tree is about 26 ft. high, and its branches cover a circumference of about 60 ft. The seeds are very important articles of food to the aboriginal inhabitants, and the property of the tribes in individual trees of the Bunya-bunya is the only possession they have, and is the commencement of a communal system amongst them. *Dendrobium Hillii* is the principal feature in the orchid house The large mass in flower has as many as twenty pale yellow racemes, some being as much as 2 ft. in length.

THE Report of the Ashmolean Society for 1872 shows that a little more life has been infused into that society during the past year, though we think there is still considerable room for improvement, and hope that next year's report will be able to speak of a considerably greater amount of work of permanent value having been done. During the year 1872 the Society has held four General Meetings, at which the following communications have been received:—A paper "On House Temperatures," by Prof. Phillips; a note "On the Meteors of April 19, 1872," by Mr. Lucas; a paper "On the Breaks of Continuity in the Mean Daily Temperature in the months of April and May," by the Radcliffe Observer; a paper "On the Sulphur Compounds in Coal Gas, and the means of removing them," by Mr. A. G. Vernon Harcourt, F.R.S.; a paper "On the Flint-implement-bearing beds of St. Acheul," by Mr. James Parker; a paper by Mr. Heathcote Wyndham "On the Recent Eruption of Vesuvius," illustrated by oil paintings of sketches made by the author on the spot.

MR. R. W. THOMSON, C.E., the inventor of the road steamer, and a man in many ways remarkable, died at Edinburgh on the 8th inst., in the 50th year of his age.

THE new strip of garden belonging to the Zoological Society on the north side of the Regent's Canal, is now being put into order. The bridge over the canal is already finished, and the new lodge opposite Primrose Hill only wants the entrance gates and turnstiles to make it complete. We understand that it will be open to the public on Easter Monday.

WE see from a leader in the *New York Tribune* of February 26, that the astounding number of almost 200,000 copies of the three cent reprint of Prof. Tyndall's lectures on light has already been sold, and that orders are still pouring in for them from all parts of the States. The *Tribune* also publishes a large number of letters from people throughout the States asking the letters to be sent them, and justly praising the enterprise of the paper in so energetically and wisely meeting a wide popular want. It reminds one of the demands occasionally seen on this side of the water for the last sensation novel or the latest news of the most recent poisoning case. Such a wide-spread taste for *Light* literature of the stamp purveyed by the *Tribune* to its multitudinous readers, is a healthy sign, and bodes well for the future of the country among whose people it exists.

WE have received a copy of a letter from Prof. Hayden, United States geologist, to his Government, asking a further appropriation of 100,000 dols. for the purpose of continuing the geological survey of the territories of the United States during the approaching season. His request is at once granted. For the coming season, the field of labour of the survey is to be transferred to the eastern portion of the Rocky Mountain Range, in Colorado, and New Mexico.

General Banks has introduced into the U. S. House of Representatives a resolution instructing the Secretary of the Navy to make an examination and survey of that section of the American isthmus which lies between Valencia Point and the Changenola River, on the Atlantic side, and the Boca Chica, the Rio Pedrigal, and the upper part of Golfo Dolce, on the Pacific side. This is to include an examination of the intervening country, of the two cordilleras, and exploration of the courses of the rivers from their outlets to their sources, within the above limits, for the purpose of ascertaining the possibility of such a connection as may be feasible for the construction of an interoceanic canal.

Miss Hannah Brakenbury has, among other large legacies, left 12,500*l*. to the Owens College, Manchester, and 9,000*l*. to Durham University.

We learn from the *Times of India* that Mr. Pogson, the Government Astronomer of Madras, has written a long letter to the local Government, suggesting that some special arrangements should be made for observations of the Transit of Venus in December 1874, in Northern India, independently of the Madras Observatory. The letter has been forwarded to the Government of India for consideration.

Les Mondes says that M. Calombel, Procureur-Général of Missions in China, after careful inquiry, gives it as his opinion that Shanghai is one of the most favourable spots for observing the forthcoming transit of Venus. The climate there is somewhat moist, but the month of December is in general very fine; and *Les Mondes* says that without doubt Shanghai will be the scene of M. Janssen's "third glorious campaign." Nankin is also a favourable station, but the inhabitants are not yet sufficiently accustomed to strangers, and the presence there of a scientific expedition might lead to a popular riot.

The Chinese take a curious method to prevent their pigeons from being attacked by birds of prey while circling over the cities or moving from place to place. This consists in the employment of small, short cylinders of bamboo, arranged so as to form a whistle or reed pipe, in groups of three or four, or more. These are attached to the back of the bird, and so adjusted that as it flies through the air a very sharp sound is produced. Varying lengths of the bamboo give variety of tones to this instrument; and when a large number of birds are flying together in a single flock, as is very frequently the case, the sound produced by them is distinctly audible for a great distance. It is said that rapacious birds are effectively repelled by this precaution, so that the pigeons make their flights with perfect safety from one point to another. Varnish is used for coating these bamboo whistles to protect them from moisture This practice is said to have been in vogue among the Chinese for a great many years.

The temperature of February of this year has shown some very curious peculiarities, and a marked contrast to that of the earlier part of the winter, as may be seen from Mr. Glaisher's tables of observations at Blackheath, published weekly in the *Gardener's Chronicle*. While, during the whole of the three preceding months there were only twelve frosty nights, with the temperature of the twenty-four hours almost uniformly above the average of the last fifty years, the thermometer fell below the freezing point in eighteen nights in February, and the temperature was below the average on every day except two, the total depression for the month being 4°·3 Fahr. The records of very few winters will show so high a minimum as 25°·0 Fahr., the lowest temperature of the past winter at Blackheath, which occurred on February 24 and 25, the thermometer falling below 30°·0 on only seventeen nights during the whole winter. Since March 2 the temperature has been again uniformly above the mean.

A very important extension of the work of the U.S. signal-office, as far as its system of weather telegraphy is concerned, is about to go into operation. It is proposed to call the post-offices of the country into requisition as intermediate agents for disseminating weather intelligence, for which purpose the territory east of the Mississippi has been divided into districts of about two hundred miles in extent each way, and each having a point of distribution near its centre, to which the "probabilities" will be telegraphed from Washington, and from which two copies of the report are to be sent to all post offices within the district which can be reached by mail as early as six o'clock P.M. each day. It is well known that country post-offices are the centres of intelligence to rural districts, and in order to afford the farmers in the community, especially, an opportunity of profiting by this information, postmasters receiving these despatches are to place a copy as soon as furnished in a conspicuous situation, where the public can see and read it.

Apropos of the correspondence going on in our columns on "Inherited Instinct," we take the following from the *Evening Standard* of March 8, though it would have been more satisfactory had the *Standard* named its authority for the statement:—During a recent gale the brig *Blue Jacket*, of West Hartlepool, from Rouen to Shields, was abandoned off Flamborough Head. The crew were taken off, but a cat was left on board. This cat had been given as a kitten to the captain twelve months ago by a lady named Mowbray, living at West Hartlepool, and had never been ashore since that time. On Wednesday last the cat made its appearance at Mrs. Mowbray's house, having swum ashore from the wreck, and travelled thence on foot. It was in a very emaciated condition.

Dr. Elsner, of Berlin, has found that iron is volatilisable at a temperature of at least 3000° centigrade. He experimented with a small piece at this heat, and on uncovering the crucible, distinguished small needles of crystallised iron, says *Les Mondes*.

We are glad to note that *Ocean Highways* has been so successful that next month it is to be considerably increased in bulk, as also in price, the size of the page being at the same time, wisely, we think, somewhat reduced. It is to be hereafter published by Messrs. Trübner.

The Japanese Government proposes to have an institution for the study of practical engineering, and have instructed their agents to procure a set of machinery and tools similar in all respects to that which the Crystal Palace Company last autumn constructed, for the purposes of their admirable school for practical engineering, under the supervision of Prof. Wilson, as Principal.

The additions to the Zoological Society's Gardens during the last week include a puff adder (*Vipera arietans*), a horse-shoe snake (*Zamenis hippocrepis*), and a lacertive snake (*Cœlopeltis lacertina*) from Morocco, presented by Sir John Drummond-Hay, K.C.B.; a Rose Hill parakeet (*Platycercus eximius*), from N. S. Wales, presented by Mrs. Hewett; two Moorish tortoises (*Testudo mauritanica*), and three Spanish terrapins (*Clemmys leprosa*), from Algeria, presented by Mr. E. C. Taylor; a crested porcupine (*Hyrtrix cristata*), born in the gardens; a Malayan bear (*Ursus malayanus*), deposited; a pig-tailed monkey (*Macacus nemestrinus*), from Java; a white-cheeked monkey (*Cibus lunatus*), from Brazil; a talapoin monkey (*Cercopithecus talapoin*), and a pluto monkey (*C. pluto*), from West Africa; a Bonelli's eagle (*Aquila bonellii*), from Morocco; two canary finches (*Serinus canarius*), from the Canary Islands; and an Iceland falcon (*Falco islandus*); all purchased.

SCIENTIFIC SERIALS

THE *American Naturalist* for February, among others, contains an article by Dr. Gill on "The Limits of the Class of Fishes," in which he endeavours to modify their generally accepted classification by dividing them up into two classes and three sub-classes, of equal significance with the reptiles and birds. The names he proposes are (1) Pisces; (2) Marsipobranchii; and (3) Leptocardii, which sufficiently indicate the genera he includes in each class. Such an amount of division we think excessive, and it would undoubtedly necessitate the removal of the crocodiles from the reptilia, among other changes. Mr. A. S. Packard gives an account of one of the beaks of a cuttle-fish, probably *Architeuthis dux*, which is four and a half inches long; he also describes other colossal specimens. There is a paper by Prof. Jordan on the colours of vegetation, one by Dr. Abbott on the habits of certain crawfish, and another by Dr. Foster on the pottery of the mound-builders, which is fully illustrated.

THE Munich *Zeitschrift für Biologie*, Bd. 8, Heft 4, contains the following papers of purely medical interest: on the occurrence of enteric fever in the Bavarian army, by Dr. Port, with charts of the mortality in the different barracks and of the amount of subsoil water; On the present state of the cholera problem, by Prof. von Pettenkofer; and on the processes of decomposition which result from venesection, by Dr. J. Bauer.

Schriften der Naturforschenden Gesellschaft in Danzig, New Series, vol. 3, Part I. The first paper in this publication of the Danzig Society is a contribution to primitive German history by Dr. Lissaicer of Danzig, being a very careful and elaborate monograph on some skulls found at Meisterswalde and Krissau, a short distance from Danzig. The paper is accompanied by some capitally executed photographs of the skulls. The next paper is also a contribution to the history of the early inhabitants of Pomerania, being a description by Herr Kasiski of the numerous and varied contents of some of the ancient graves which abound in the district around the village of Persanzig, on the river Persante, a short distance west of Neustettin. The district abounds with material for the archæologist. The paper is accompanied with numerous illustrations of the contents of the graves. The next paper is a long one by Dr. C. J. H. Lampe, of Danzig, on the Movement of Water in pipes, accompanied by some calculations as to the pressure and speed of the water in the pipes by which Danzig is now supplied with water from a considerable distance. This paper is also illustrated, as is also the last one, which is the fifth part of A. Menge's Catalogue of Prussian Spiders.

Der Zoologische Garten (Frankfurt a. M.), January 1873, contains an excellent article, with maps in illustration, of the geographical distribution of the Birds of Paradise, with which are included *Epimachus* and Ptiloris. There is also an article by Dr. H. Dorner on the tongue of the Ka-ka Parrot (*Nestor meridionalis*), in which he shows clearly that in structure it presents none of the characters of the *Trichoglossinæ*, and in other points his results quite agree with those read before the Zoological Society of London in June last, although he, following Dr. Finsch, does not feel disposed to remove this parrot from among those with trichoglossal tongues, because of a supposed similarity in their beaks, which we find it difficult to appreciate, the Ka-ka's being black and ribbed, whilst that of Lorius is smooth and with an orange tint. There is not the least doubt that, now it has been doubly demonstrated that their tongues are not similarly constructed, there is not any good reason for associating the Nestors with the Lories.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 6.—"On the Vapour-density of potassium."—Preliminary notice. By James Dewar and William Dittmar.

The results of their observations conclusively show that the density of potassium-vapour, as produced in the process described, cannot exceed 45 times that of hydrogen, and that therefore the molecule of potassium consists of *two atoms* (K_2).

"On New Sources of Ethyl- and Methyl-Aniline." By John Spiller, F.C.S.

"On a new genus of Amphipod Crustaceans. By Rudolph von Willemoes-Suhm, Ph.D., Naturalist to the *Challenger* exploring expedition.

In lat. 35° 47′, long. 8° 23′, off Cape St. Vincent, the trawl was sent down to a depth of 1090 fathoms on the 28th of January, and brought up among other very interesting things a large, transparent Amphipod with enormous facetted eyes. The animal, evidently hitherto unknown, will be the type of a new genus, having the following characters:—

THAUMOPS, nov. gen.

Caput oblongum, inflatum, oculis maximis superiorem capitis partem tegentibus. Segmenta thoracica 6, abdominalia 5. Antennarum in feminis par unum, maxillarum par unum, pedum paria duo minima maxillarum locum tenentia. Mandibulæ nullæ. Pedes thoracici 5, abdominales 3 in quoque latere. Appendices caudales 4. Gangliorum pectoralium paria 5, abdominalium 3.

T. pellucida, n. sp.

Corpus longitudine 14 mm., latitudine 21 mm., pellucidum.

It could not be made out whether *T. pellucida* inhabits the deep sea, or whether it is, like *Phronima*, a pelagic animal, having been caught by the trawl only as the latter came up from the depth.

Geological Society, February 26.—Prof. Ramsay, F.R.S., vice-president, in the chair.—The following communications were read:—"On the Jurassic Rocks of Skye and Raasay," by Dr. James Bryce. In this paper the author described numerous sections of Jurassic rocks exposed chiefly in the sea-cliffs of Skye and Raasay, indicating the presence in those islands of a complete series of beds ascending from the Lower Lias to the middle of the Middle Oolite. He noticed the occurrence in these sections of fossils belonging to the zones of *Ammonites angulatus* and *A. Bucklandi* in the Lower Lias, to the zones of *A. Jamesoni*, *A. capricornus*, *A. margaritatus*, and *A. spinatus* in the Middle Lias, of Upper Lias fossils, including *Ammonites communis*, *falcifer*, *heterophyllus*, and *bifrons* and of others indicating beds belonging to the Inferior Oolite and Cornbrash, and to the Oxford Clay. The Loch Staffin beds were described as an estuarine series, nearly approaching the Oxford Clay in geological age, and including a bed almost entirely made up of shells of *Ostrea hebridica*. The whole series of Jurassic rocks in these islands reposes on the Toridon sandstone of Cambrian age; and the author discussed the question whether or not the intervening beds have ever existed in this locality, and came to the conclusion that they probably existed, and have been swept away by denudation. He remarked further upon the resemblance in lithological characters of the beds described with the corresponding deposits elsewhere in Britain. The traprocks intruded between the Jurassic deposits he regarded as of post-oolitic date.—"Observations on the more remarkable Boulders of the North-West of England and the Welsh Borders," by Mr. D. Mackintosh. In this paper the author described the situation and indicated the probable origin of many of the more striking known boulders in Westmoreland, Cumberland, Lancashire, Cheshire, and on the borders of Wales. The northern boulders seem to have orignated chiefly from Wastdale Crag, Criffel, Ennerdale, and Eskdale; those of Cheshire chiefly from the Lake District and South of Scotland; and many of those on the Welsh borders from the mountains of Wales. Many of the boulders noticed by the author exhibit glacial striæ. The author also especially referred to the occurrence of boulders at high levels.

Linnæan Society, March 6.—Mr. Bentham made some observations on the homology of the perigynium or utricle of the female flowers of Carex and Uncinia, with a view to calling to the disputed points in question the attention of botanists used to microscopical investigation, who may have the opportunity of examining living specimens in the earliest stages of flowering. Two principal explanations of the homology of the perigynium of Carex have been given. Brown, relying upon its being composed of two squamæ, considered that it represents a perianth, and Payer and Schleiden have adopted the same view, after an examination of its appearance at a very early stage. Kunth, on the contrary, believed it to be formed of a single scale, and to be an ordinary glume subtending the female flower on a secondary axis, of which the seta of many species of Carex, and of all the species of Uncinia, is the continuation. If the perigynium is really formed of a single scale, Kunth's view is very plausible, but the two keels or principal nerves, which in most species end in two points or lobes, are strong evidences of its double nature. Kunth explains that circumstance by the suppression of the central nerve or keel owing to pressure, of which, however, there is no appearance in any species examined. Payer states also positively that the two are distinct at an early stage, and unite as they grow up; but implicit reliance is not always to be placed upon his having always clearly seen the minute microscopic and obscure protuberances he delineates. Schleiden delineates the two parts of the perigynium and the seta as forming three parts of one whole; but his drawing is not to be depended upon, as he places them in a wrong position with relation to the axis and the subtending glume. Kunth confirms his views by a comparison with the palea and occasional seta of Gramineæ, but here the position of the two parts in the two orders is by no means homologous. Independently of the relation to the other parts of the flower, the seta or prolonged axis in Gramineæ is outside the paleæ, in Carex inside the perigynium. A stronger confirmation is taken from two South African species of Schœnoxiphium (not generically distinct from Carex) in which the seta occasionally bears a spike of male flowers. This spike appears to be sterile, and may be a case of prolification, but requires further investigation. If it be a normal spike, we must conclude the perigynium or subtending glume to be formed of one scale; for two opposite scales at the base of an alternate inflorescence is a derangement of the ordinary course of change from the alternative vegetative organs to the opposite or whorled floral organs, which is believed to have no example at least in Monocotyledons. If the perigynium is formed of two scales they must belong to the floral whorls. They are not subtending bracts analogous to the two free bracts of Diplacrum, or the united ones of Hoppia, for in both those cases the female flowers are terminal without any other subtending glume, and in Carex the female flower is lateral, and the perigynium is within one outer subtending glume. That they are two out of three parts of a real perianth is rendered improbable by their great development in one sex in an order where it is in all other genera suppressed or rudimentary, and without any trace of it in the other sex. The only remaining supposition is that the perigynium and seta represent the stamens of the male flowers, and are therefore in fact staminodia. The position with relation to the axis and subtending glume is the same, and although they are very different in form and texture, that difference is much diminished in *Uncinia longifolia* where the dilated filaments of the males assume the aspect nearly of the perigynium of the females. The lobes of the perigynium in *Carex subulata*, and occasionally in some Unciniæ, have the look of the seta of Uncinia, and in one instance that seta bore a perfect anther. Brown confirmed his view of the perianth-nature of the perigynium by a specimen of *Carex acuta* with stamens within the perigynium. An examination of beautiful specimens of this form of *Carex acuta*, gathered by Mr. Spruce in Yorkshire, shows, from the position and structure of the stamens bearing perigynia, that they are altered female flowers in which more or less imperfect stamens replace the carpellary leaves of which the pistil is formed. If this homology of the perigynium with the andrœcium of the male flower is thought plausible, it is still doubtful, and the doubt can only be solved by a careful repetition of Payer's observations, and a repeated study of the anomalies of Schœnoxiphium, and of those species of Carex in which the seta is variously developed, many of the forms delineated in the late Dr. Booth's splendid illustrations of the genus requiring a special study on the specimens themselves.

Zoological Society, March 4.—Mr. John Gould, F.R.S., V.P., in the chair.—Mr. Edwin Ward exhibited the original leg-bones of *Dinornis maximus*, from Glenmark Swamp, near Christchurch, New Zealand, described by Prof. Owen in the Society's "Transactions," belonging to Col. Michael.—A communication was read from the Rev. O. P. Cambridge on the spiders of St. Helena, founded on the collections made in that island by Mr. Melliss. The total number of known spiders of St. Helena was stated to be forty, of which eleven were now described for the first time. The species were mostly European in form.—A communication was read from Dr. John Anderson, F.Z.S., Curator of the Indian Museum, Calcutta, on the species and dentition of the Southern Asiatic Shrews, preliminary to a proposed monograph of the group.—A communication was read from Mr. M. R. Butler, being the description of a remarkable new species of butterfly, of the genus *Tanaëcia*, from Penang.—Messrs. P. L. Sclater and O. Salvin read a paper on the birds of Eastern Peru, with notes on the habits of the birds by Mr. E. Bartlett. The total number of species hitherto recorded as met with in the district was stated to be 473, of which 108 were unknown elsewhere.—A communication was read from Surgeon-Major Francis Day on some new or imperfectly known fishes of India.—A communication was read from Mr. G. E. Dobson, M.B., on secondary sexual characters in the Chiroptera. Mr. Dobson pointed out that, contrary to what Mr. Darwin had believed to be the case, special structural characters existed in the males of species of the genera *Phyllorhina Taphozous*, and other genera of bats.

Anthropological Institute, Feb. 18.—Prof. Busk, F.R.S., president, in the chair. Sir John Lubbock, Bart. exhibited two heads of Macas Indians, and contributed a note of the mode of their preparation. Mr. W. Topley read a paper "On the Relation of Parish Boundaries in the south-east of England to Great Physical Features, particularly to the Chalk Escarpment."

March 14.—Prof. Busk, F.R.S., president, in the chair.—A paper was read by Dr. A. Campbell "On the Looshais," a people inhabiting the hill district of Chittagong. They are fairer in complexion than the people of the plains, and their features resemble those of the Malays rather than the Tartar-like people of Mumpore. They have no distinction of caste; marriage is a civil contract, dissolvable at the will of both husband and wife. The men live by hunting, whilst the women are engaged in household work.—Sir Duncan Gibb read a paper on "Stone Implements and Pottery from Canada." After describing a collection of arrow and spear heads, some hatchets, and pottery collected by himself in various parts of Canada, he considered the first two as the most ancient implements found in that country, for reasons which he gave, and placed the period of their use at about 200 B.C., although he saw no reason why they might not have been employed 4,000 years ago.—Mr. Hodder M. Westropp contributed a short paper on "The Ventnor Flints," descriptive of fragments of flint and other stone, bearing resemblances to the true arrow-heads and implements of ancient manufacture; and it was shown that the specimens exhibited were wanting in the bulb of percussion and the chipping at the edge which characterised the genuine articles.—The President described an Australian skeleton from the Murray River, which had been sent to the museum of the institute by Dr. Robert Peel, of Adelaide. It was announced that further committees had been appointed for Physical Characters of Mankind; Priscan Archæology; and Descriptive Ethnography.

Chemical Society, March 6.—Dr. Gladstone, F.R.S., vice-president, in the chair. The following communications were read: "On the action of hydrochloric acid on codeine," by Dr. C. R. A. Wright, being a continuation in the codeine series of the author's former researches on morphine. "On new processes for mercury estimation with some observations on mercury salts," by J. B. Hannay. "On a method of estimating nitric acid," by T. E. Thorpe, F.R.S.E., the process depending on the ease with which nitric acid is converted into ammonia by the copper-zinc couple of Messrs. Gladstone and Tribe. "Note on a reaction of the acetates upon lead salts with remarks on the solubility of lead chloride," by F. Field, F.R.S. "Observations on the nature of the black deposit in the copper-zinc couple," by J. H. Gladstone, F.R.S. and A. Tribe, F.C.S. "On an air-bath of constant temperature between 100° and 200° C.," by Dr. H. Sprengel. This consists of a bath similar to the ordinary chemical hot-water oven but made of sheet-lead and filled with dilute sulphuric acid of such a strength as to boil at the desired temperature.

Entomological Society, Feb. 17.—Prof. Westwood, president, in the chair.—Mr. Bond exhibited bred specimens of *Acronycta tridens* and *A. Psi*, showing the differences between the two species.—Mr. Müller exhibited some spiral cases of a species of *Psyche*, and also the egg-case of a species of *Mantis*, both sent from Calcutta by Mr. James Rothney.—Prof. Westwood exhibited two dipterous larvæ preserved in spirits, discharged by a woman in a clot of phlegm, which were probably larvæ of *Psila rosæ*, swallowed with raw carrots. After they had been immersed in spirits for three or four days he took them out for examination, and was surprised to find that they were still alive. He also showed drawings of vine-stems, with excrescences caused by a beetle (*Otiorhynchus*).—Mr. H. W. Bates read a paper on the geodephagous beetles of Japan, collected by Mr. George Lewis.—Mr. Müller read a list of entomological works and papers, no notice of which was to be found in Dr. Hagen's "Bibliotheca Entomologica."—Mr. F. Smith read some remarks by Prof. Siebold, on the salivary organs of the honey-bee.

March 3.—Prof. Westwood, president, in the chair. Mr. Vaughan exhibited a box containing about 200 specimens of Japanese *Lepidoptera* collected by Mr. Henry Pryer, near Yokohama. —Mr. T. Smith exhibited insects bearing a remarkable resemblance to each other, although belonging to different orders. *Euglossa dimidiata*, a bee, had a striking resemblance to a species of the Dipterous Genus *Asilus* from South America. Also *Abispa splendida*, one of the *Vespidæ*, resembled an insect of the Dipterous genus *Laphria;* both from N. Holland. Also a bee of the genus *Megachile* resembled an *Asilus*. The two last-mentioned resembled each other, not only in general appearance, but the *Asilus* was also furnished on the under side with a pollen brush, in the same manner as in *Megachile*, although it was not apparent for what purpose the insect required it. The president remarked that when he was at Ancona he observed several insects of the genus *Osmia* and *Megachile* extracting pollen from black poppies, and on the sandy shore he noticed the same insects collecting the sand. He therefore concluded that the pollen brushes were used, not only for collecting the pollen, but also for carrying the grains of sand to their nests. It was probable, therefore, that the *Asilidæ* that were furnished with brushes might use them for a similar purpose. Mr. Champion exhibited *Bagous brevis*, taken in this country for the first time by Dr. Power.—Mr. Müller directed attention to an article in the *Petites Nouvelles* explaining a method of obtaining silk from cocoons which had been eaten through by the insects—and that the silk so obtained from the damaged cocoons was equal in quality to that obtained from the perfect cocoons.

Royal Horticultural Society, March 5.—Scientific Committee.—J. D. Hooker, M.D., C.B., F.R.S., in the chair. A note was read from Dr. Boswell Syme on the intra-palear fertilisation of wheat. He found that the anthers are *empty* when they are extended, and that the stigmas are never extended beyond the pales at all.—Mr. A. W. Bennett read an abstract of a paper by Hildebrand, on the same subject.—The Rev. M. T. Berkeley exhibited specimens of a fungus, *Cladosporium herbarum*, from the inner surface of the shell of a boiled egg.—General Meeting. —W. Wilson Saunders, F.R.S., in the chair. Prof. Thiselton Dyer made some remarks on a cone of *Araucaria Bidwilli* from the tree in the temperate house at Kew, on specimens of *Dendrobium Hillii* and *Clematis indivisa*, a fine species from New Zealand, and also on *Amorphophallus Rivieri*, a remarkable Aroid with inflorescence, shown by Mr. Bull. It had been introduced by the French into the Jardin d'Essai at Algiers, from Cochin China.

Royal Microscopical Society, March 5.—Chas. Brooke, F.R.S., president, in the chair. Mr. E. J. Gayer contributed some further notes on the micro-spectroscope and microscope, in continuation of his paper upon the same subject, read at the December meeting of the Society.—A paper by Dr. Maddox, on a minute plant found in an incrustation of carbonate of lime, was also read to the meeting, and was illustrated by drawings and prepared specimens exhibited under the microscope, by Mr. Reeves.—The secretary stated, with reference to some crystals shown at the previous meeting, obtained from the condensed vapour of coke, that they had been examined by Mr. Bell, and found to consist chiefly of protosulphate of iron.—A new metallic chimney for microscope lamps was introduced by Mr. Wenham, its merits being explained by the secretary, and discussed by the meeting.

Cambridge

Philosophical Society, Feb. 3.—Professor Humphry, president, in the chair. It was decided to admit as associates residents in Cambridge and the neighbourhood, not being graduates. Associates to be elected for a period of three years, and if not then graduates to be eligible for re-election. The president in an eloquent address dwelt upon the loss which the Society had sustained by the death of Prof. Sedgwick, its founder and ever-ardent supporter. The following communications were made by Prof. Clerk Maxwell: "On the proof of the equations of motion of a connected system," and "On a problem in the calculus of variations in which the solution is discontinuous."

Feb. 17.—The following communications were made by Mr. Paley "On the name *Odusseus* signifying 'setting sun,' and the Odyssey as a solar myth." This showed that the name was most probably connected with δυόμενος ἥλιος (setting sun) and that the details of the Odyssey were easily interpreted as a solar myth, describing the journey of the sun to the west and his return after many struggles and adventures to his ever-young bride in the east, Penelope the spinstress, *i.e.* the cloud-weaver.—"On the identity of the modern Hindu with the ancient Greek ship." A model of the former (Bengalee) was exhibited and the close coincidence in build, rig, and tackling was pointed out; and several difficulties in the allusions of classic authors to the parts of a ship were thus explained.

Manchester

Literary and Philosophical Society, Feb. 18.—E. W Binney, F.R.S., vice-president, in the chair. Dr. Joule, F.R.S., gave some further account of the improvements he had made in his air-exhausting apparatus (See NATURE, vol. vii. p. 296). "Notes on a supposed Glacial Action in the Deposition of Hematite Iron Ores in the Furness District," by William Brockbank, F.G.S. The hematite iron ore deposits in the Furness district are of two very different varieties—(1) Those filling hollows in the limestone, covered only by the post tertiary gravels and clays, and (2) Those occurring in the carboniferous limestone in veins, and large irregular cavities or "pockets." The superficial deposits (1) are more especially the subject of the present communication, as they afford, in the writer's opinion, undoubted evidence of glacial action, and of the mode in which the iron ore has been transported by its agency. "The Results of the Settle Cave Exploration," by W. Boyd Dawkins, F.R.S. Since the results of the exploration of the Settle Caves were brought before the British Association at Liverpool, in 1870, considerable progress has been made in the further investigation of the remarkable contents of the Victoria Cavern. Up to that time our researches had revealed, perhaps, the most remarkable collection of enamelled jewellery which had ever been discovered in one spot, along with broken bones of animals and the implements of everyday life, which afforded a pointed contrast to the culture implied by the workmanship of the articles of luxury. The Roman coins, and the style of workmanship of the implements, pointed out that the cave was occupied during the troublous times when the Roman Empire was being dismembered by the invading barbarians, and when Britain, stripped of the Roman legions, was falling a prey either to the Picts and Scots on the one hand, or to the Jutes, Angles, and Saxons on the other. If we stretch the limits of the occupation to the latest, they cannot be held to extend nearer to our own times than the Northumbrian conquest of Elmet (or kingdom of Leeds and Bradford) by Eadwine, in the year A.D. 616, that was preceded in 607 by the march of Æthelfrith on Chester, and the great battle near that Roman fort, celebrated in song for the defeat of the British and the slaying of the monks of Bangor. At that time the Northumbrian arms were first seen on the shores of the Irish Channel, and the fragment of Roman Britain—which had extended on the western part of our island, from the estuary of the Severn uninterruptedly, through Derbyshire and Lancashire into Cumberland—was divided, never again to be united. The Roman civilisation, which had up to that time been maintained in that district, disappeared, and was replaced by the civilisation which we know as English. The traces, therefore, of Romano-Celtic ornaments and implements from the Victoria Cave must be assigned to the period before the English conquest, before the Northumbrians conquered West Yorkshire and Mid-Lancashire. Underneath the stratum containing the Romano-Celtic or Brit-Welsh articles, at the entrance of the cave, there was a thickness of about six feet of angular stones, and at the bottom of this a bone harpoon or fish-spear, a bone bead, and a few broken bones of bear, red deer, and a small short-horned ox prove that in still earlier times the cave had been inhabited by man. A few flint flakes probably imply that these remains are to be referred rather to the Neolithic age than to that of Bronze. Below this was a layer of stiff clay, into which the committee sank two shafts, respectively of twelve and twenty-five feet deep, without arriving at the bottom. They have, however, at last penetrated it, and have broken into an ossiferous bed, full of the remains of extinct animals, similar to those which have been discovered at Kirkdale and elsewhere; consisting of the cave-bear, cave hyæna, woolly rhinoceros, mammoth, bison, reindeer, and horse. The bottom has not been reached, and the area exposed is so small that it is impossible to say whether man was living in the cave at this time or not. The clay immediately above it is considered, both by Mr. Boyd Dawkins and Mr. Tiddeman, to be of glacial origin, and in that case this cave is the only one in Great Britain which has offered clear proof that this group of animals was living in the country before the glacial age. It may be that the remains of man may be discovered here, as in the caves of Wookey Hole, Kent's Hole, and Brixham; but this problem can only be solved by an exploration on a larger scale, which the committee hope to be able to carry on by the aid of further subscriptions, and which the British Association has thought sufficiently important to aid by a grant of 50*l*. The problem which they are attempting to solve, is not merely of local interest, but, one which is worthy of the aid of all who care for the advancement of knowledge. "The explorations of the Victoria Cave," writes Mr. Tiddeman, "carry with them more than common interest, from the probability of making out in this district the relation of the older cave mammals (and perhaps of man) to the Glacial period. The complete absence of this fauna from the river gravels and other Post-Glacial deposits of this district, taken with the former existence of a great development of ice over the northern counties, renders it highly probable that the latter was the agent which removed their remains from all parts of the country to which it had access, leaving them only in sheltered caves. In this cave we find, above the beds containing the older fauna, a deposit of laminated clay of great thickness, differing so much from the cave-earth above and below it as to point to distinct physical conditions for its origin. Clay in all respects similar, but containing scratched stones, has been found intercalated with true glacial beds in the neighbourhood, thus rendering the glacial origin of that in the cave also highly probable. Moreover, at the back of a great thickness of talus at the entrance glaciated boulders have been found, resting on the edges of the beds of lower cave-earth containing the older mammals. All points considered, there is strong cumulative evidence pointing to the formation of the lower cave-earth at times at any rate prior to the close of the Glacial period and probably earlier. It is to be hoped that further investigations may settle these and other most important questions." The objects found in the Victoria Cave will not be removed from the county, but will be placed in a museum attached to the Grammar School at Giggleswick.

DUBLIN

Royal Irish Academy, Jan. 13.—The Rev. Prof. Jellett, president, in the chair. Mr. B. O'Looney read a paper on the contents of the Book of Leinster.—Mr. W. H. Bailey, F.G.S., read a paper on a new species of Labyrinthodont Amphibian from Jarrow Colliery, Co. of Kilkenny. This species the author said was, he believed, identical with the species referred to in Messrs. Huxley and Perceval Wright's paper on fossil vertebrata from County Kilkenny, as being "a large amphibian, closely allied to, if not identical with, the *Anthracosaurus* of the Scotch coalfield," and of which he had been shown some very fine specimens in the British Museum. He proposed to call this species *A. edgii*.

Jan. 27.—Rev. Prof. Jellett, president, in the chair. Prof. E. Perceval Wright read a report on *Hyalonema mirabilis*.

Feb. 24.—Lord Talbot de Malahide, vice-president, in the chair. The Rev. Prof. Jellett, president, read a paper on sugar-beet grown in Ireland in 1872, in which he stated that, having frequently heard it said that Ireland was not a country in which the beetroot could be successfully cultivated, he had been led to make several experiments on the subject. The results in 1871, which was a dry and sunny year, and those he had obtained in 1872, which was one of the wettest and coldest, presented very little difference. He had been furnished last year from the Albert Model Farm, Glasnevin, with four specimens of sugar-beet, in the growth of one of which the manure used was common salt; in the second case, sulphate of potash; in the third case no manure was used; and in the fourth instance, sulphate of ammonia. He had by optical experiment determined with accuracy that in the first case there was a yield of 79·99 per cent. of water and 12·72 per cent. of sugar; in the second, 80·27 of water and 13·18 of sugar; in the third, 80·60 water and 12·42 sugar; and in the last, 80·52 water and 11·85 sugar. The average of these was 80·34 per cent. of water and 12·54 per cent. of sugar. The amount of sugar thus found to be contained in the Irish-grown beet was quite equal to that in beet grown in Germany, Belgium, and France, and proved Ireland to be a country in which sugar-beet might be cultivated with advantage.

EDINBURGH

Scottish Meteorological Society, Jan. 30, half-yearly meeting.—Mr. Milne Holme in the chair.—Mr. Buchan made a statement with reference to the remarkable weather which has prevailed in this country during the past year. The specialty of that year's weather was, he said, its rainfall. The mean rainfall for sixteen years of the whole of Scotland, as indicated by the average of 55 stations, was 39, 1-5th in. The year 1857 was a dry year, its rainfall being 8 in. less than the mean; 1858 fell below the mean by 5 in.; 1861 was 6 in. above the mean; but the rainfall of last year ran up to 15 in. above the mean, the average rainfall of the whole of Scotland during that year being 54 in. This rainfall was 38 per cent. above the mean, and there was nothing approaching it in any of the previous sixteen years. This enormous rainfall was very unequally distributed over the country. He had constructed a map of Scotland based upon the returns from 200 stations. In this map a blue line passing round the north of the Shetland Islands, cutting off the north-west fringe of Caithness and Sutherland, and then bending down southward, but returning northward again so as to pass round the north of the Hebrides, cut off a part of Scotland within which there was last year less rain than usual. Between this and another line which stretched from Shetland, took in part of Orkney, curved down round Islay, and took off a part of the Hebrides, was included a portion of the country where the rainfall did not amount to 25 per cent. above the average. Then suppose a line beginning about Peterhead, curving round so as to include Elgin, and following very closely the east watershed of Scotland, all places to the east of that line were found to have had at least half more rain than usual. Further, the country about Aberdeen and a good part of East Lothian and Berwickshire had an excess above the average to the extent of 75 per cent. Not only so, but taking some of the individual stations, it appeared that Culross, the highest the society had, stood 93 per cent. above the average; Thurston, near Dunbar, 88 per cent. above the average of thirty-two years; Jedburgh, 84 per cent. above the average; and other places fully 80 per cent. above the average. These figures showed a very remarkable distribution of the rainfall for the last year; he thought the records of meteorology had nothing like it. In Castle Gordon, Banffshire, the rainfall of last year was 5¾ in. above any rainfall in the previous ninety years. At Edinburgh there were sixty years' observations to go back upon, and last year's rainfall exceeded to the extent of over 4 in. any recorded within that period. With reference to the distribution of rain over the year, the fall in January was greatly in excess of the average, and it only fell below the average in April, every other month showing an excess. On the east side of Scotland, taken as a whole, every month of last year was above the average—an unprecedented fact, he thought, in Scottish meteorology. In the west of Scotland, one month was decidedly under the average, and another month stood at the average, every other month being above the average. June was a very wet month in the west. August was a drier month. September appeared rather wet, but that was due to the greater rainfall in the south, for to the north of Islay the rainfall of that month was very much under the average. As to temperature, for the first four months it was above the average; in May and September very much under the average; June about the average; July above the average, and so on; so that in this respect the year was not on the whole a very bad one. With regard to barometric pressure, he had worked out the mean of 55 stations, and it appeared that for every month, except July and August, the pressure of Scotland was under the average. Northerly, north-easterly, easterly, south-easterly, and southerly winds were above the average; and the distribution of rain was the representative of that fact, a great proportion of the rain that fell having been brought by easterly winds. The atmospheric pressure in Iceland was above the average in every month except January, and during the whole year the pressure in that island was much higher than with us. In the north of Norway the pressure was still higher than in Iceland, and showed a more irregular curve. Following out this point in other parts of Europe, it appeared that in England the pressure was under the average; in Guernsey it was under the average each month, and a similar state of matters prevailed in Ireland, France, Switzerland, Germany, and Austria. On the other hand, in Iceland, the northern part of Norway and Sweden, in Russia, at Constantinople, at Athens, at Moscow, in the north of Africa, and in Spain, pressure was above the average, and the rainfall for the year less than the average. So far as the facts went it did not seem to him that the rainfall of the whole globe during last year was larger than usual. In the West Indies it was a very dry year up to the beginning of November. In the United States, at least till the end of September, it was drier than usual, and in the north of Europe much drier than usual. In short it seemed that the rainfall of the year instead of being more evenly distributed, as usually happened, had been more concentrated in Scotland, England, France, Italy, south of Norway, Germany, and Austria.

PARIS

Academy of Sciences, March 3.—M. de Quatrefages, president, in the chair.—The following papers were read:—"On the Elliptical Oscillation of Solar Cyclones," by M. Faye. The paper dealt mainly with the mathematical nature of the spots, and the author gave a table in which he showed the exact resemblance which can be traced between the solar and terrestrial cyclones.—"On the Action of the Electric Current on a Mixture of equal volumes of Methene and Carbonic Anhydride," by MM. P. and A. Thenard. The authors find that the silent discharge, when allowed to act on the above mixture, produces a clear, limpid fluid, but that the spark causes an expansion of the gases sometimes accompanied by a deposit of carbon. No analysis of the liquid was given.—"On the Nature and Origin of the Solar Spots," a letter from Father Secchi, who believes that, even admitting M. Faye's cyclones, yet the cause of these must be sought in eruptions. He asserts that he did not say, as M. Faye supposed, that the spots *were* eruptions, but that they were *produced by* eruptions.—The Academy then proceeded to elect a member of the physical section in the place of the late M. Duhamel. M. Berthelot obtained 33 votes, M. Desains 23, and M. Le Roux 4. M. Berthelot was accordingly elected.—A report on a memoir by M. Kretz on the elasticity of moving machines was read.—A paper on the botanical geography of Morocco, by M. F. Cosson, followed; and next came a paper on geodetic operations, by Col. H. Levret, and one on the simultaneity of barometric variations in the high latitudes of either hemisphere, by M. J. A. Broun.—M. B. Renault presented a paper on the fructification and on the structure of the stems of *Annularia* and *Sphenophyllum*.—M. Chasles presented a paper on the trajectories of the points of a straight motion in space, by M. A. Mannheim, and a note on double curves of the sixth order, by M. Ed. Weyer.—M. L. Joulin sent a paper on saline decomposition, a paper relating to the part played by the water used to dissolve a body, when that body is precipitated by means of another.—MM. Troost and Hautefeuille sent a second instalment of their paper on the solution of gases in molten cast-iron. They find that a highly silicious iron scarcely dissolves any hydrogen.—M. Gernez presented another paper on the action of films on supersaturated solutions.—M. Pasteur presented a paper by M. J. Chautard, on the modification of the chlorophyll absorption spectrum, produced by the action of alkalies. The alkalies cause the appearance of a second band in the red.—MM. Houzeau and Renard presented a paper on the use of concentrated ozone in investigations in organic chemistry, and on "ozobenzine." The latter is a gelatinous body produced together with formic and acetic acids by the action of ozone on pure benzine.—Mr. T. L. Phipson sent a note on Anthracenamine.—M. Wurtz presented a second note on the derivatives of Tetrachloride of naphthaline, by M. Grimaux.—This was followed by M. P. Bert's ninth note on the effects of changes of barometric pressure on life. MM. P. Fischer and de Tolin sent a note on the bathymetric exploration of the fosse at Cape Breton, and M. J. Jullien a note on the respiration of the *Psammodroma*.

DIARY

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 8.30.—Note on Supersaturated Saline Solutions: C. Tomlinson.—Visible Direction: Dr. Jago.

SOCIETY OF ANTIQUARIES, at 8.30.—Excavations in the Troad: Dr. Schliemann.

LONDON MATHEMATICAL SOCIETY, at 8.—On an Extension of the term *Area* to a closed curve of double curvature or Skew Polygon: R. B. Hayward.—On the Evaluation of a class of Definite Integrals involving Circular Functions in the Numerator, and powers of the Variable only in the Denominator: J. W. L. Glaisher.—Note on Normals and the Surface of Centres of an Algebraical Surface: S. Roberts.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

FRIDAY, MARCH 14.

ROYAL INSTITUTION, at 9.—Coral Reefs and their Architects: Prof. Allman.

ASTRONOMICAL SOCIETY, at 8.

QUEKETT CLUB, at 8.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

SATURDAY, MARCH 15.

ROYAL INSTITUTION, at 3.—On the Philosophy of the Pure Sciences: Prof. W. K. Clifford.

SUNDAY, MARCH 16.

SUNDAY LECTURE SOCIETY, at 4.—The Education of Women: Mrs. Fawcett.

MONDAY, MARCH 17.

ENTOMOLOGICAL SOCIETY, at 7.

ASIATIC SOCIETY, at 3.

LONDON INSTITUTION, at 4.—Physical Geography: Prof. Duncan.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

TUESDAY, MARCH 18.

STATISTICAL SOCIETY, at 7.45.

ANTHROPOLOGICAL SOCIETY, at 8.—On "Theories regarding Intellect and Instinct," and "The Concurrent Contemporaneous Progress of Renovation and Waste: George Harris.

ZOOLOGICAL SOCIETY, at 8 30—On some Marine Mollusca from Madeira, including a new genus of the *Muricidæ*. Communicated by Mr. Gwyn Jeffreys: R. B. Watson.—On a specimen of *Acanthias vulgaris* and a species of *Galeus*, probably new, taken off Flinder's Island, Bass' Straits: Dr. John Denis Macdonald—Note on the Gazelles of India and Persia, with description of a new species (*Gazella fuscifrons*): W. T. Blanford.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, MARCH 19.

SOCIETY OF ARTS, at 8.—On certain improvements in the Manufacture of Printing Types: J. R. Johnson.

METEOROLOGICAL SOCIETY, at 7.—On some results of Meteorological Telegraphy: R. H. Scott.—On the Barometric Depressions of Jan. 24, 1872: Wm. Marriott.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

LONDON INSTITUTION, at 7.—Travers Course (Lecture I).

THURSDAY, MARCH 20.

ROYAL INSTITUTION, at 3—The Chemistry of Coal and its Products: A. V. Harcourt.

CHEMICAL SOCIETY, at 8.—On Iron and Steel: C. W. Siemens.

LINNEAN SOCIETY, at 8.—On the "Take-all" Corn Disease of Australia: Dr. Mücke.

PAMPHLETS RECEIVED

ENGLISH.—Report of the Marlborough Natural History Society.—Journal of the Iron and Steel Institute, No. 4—Quarterly Journal of the Meteorological Society.

AMERICAN.—Annual Report of the Survey of the Northern and North-Eastern Lakes: C. B. Comstock (Washington).—Movable Torpedoes: Capt. Ericsson.—On a new Sub-Class of Fossil Birds.—On the Gigantic Fossil Mammals of the order Dinocerata: Prof. O. C. Marsh.

FOREIGN.—Introduction a l'Etude de la Nutrition des Plantes, &c.: E. Morren.—Report of the Proceedings of the Meteorological Conference at Leipzig, 1873.—Cosmos, No. 1.

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THURSDAY, MARCH 20, 1873

PERCEPTION AND INSTINCT IN THE LOWER ANIMALS

THE correspondence in these columns, called forth by the letters of Mr. Darwin and Dr. Huggins (NATURE, Feb. 13), may be counted among the many indications of the growing interest in psychology; while at the same time it furnishes evidence of how far our knowledge of mind is behind most of the other sciences. Of the important points in the valuable letters of Mr. Darwin and Dr. Huggins we shall speak presently. But let us remark first on the minor and distinct question raised by Mr. Wallace. He says: "The power many animals possess to find their way back over a road they have travelled blindfolded (shut up in a basket inside a coach, for example), has generally been considered to be an undoubted case of true instinct. But it seems to me that an animal so circumstanced will have its attention necessarily active, owing to its desire to get out of its confinement, and that by means of its most acute, and only available sense, it will take note of the successive odours of the way, which will leave on its mind a series of images as distinct and prominent as those we should receive by the sense of sight. The recurrence of these odours in their proper inverse order—every house, ditch, field, and village having its own well-marked individuality—would make it an easy matter for the animal in question to follow the identical route back, however many turnings and cross-roads it may have followed." The objections to this hypothesis, to which Prof. Robertson has given his adhesion, are very serious. Let the scent of the dog be ever so acute, it is in many ways ill suited for supplying the kind of guidance required. A hound on the track of a hare has to follow a stream of the same scent. The association here is between the hare and the smell of the hare. Are not the associations of smell all of this kind? Is there any evidence that either in man or beast one smell ever coheres to another so as to render possible a memory of odours apart from the objects that give them forth? We are not very certain about the facts which the theory is put forward to explain; they are, however, better authenticated than is the fundamental assumption involved in the explanation. But, for the sake of argument, let us grant that a dog shut up in a basket can, as the result of a simple experience, link together several thousand smells in an unbroken series; say, the stink of a dung-hill is associated with the odour of sweet hay, this with the scent of a flock of sheep passed on the road, this again with the smell of a railway station to the right, and so on during a journey of sixty or seventy miles. If it be solely by the aid of this memory of smells that the dog is to return to the place whence it was taken, it must needs make haste back. It will be too late if the sheep have changed their position on the road. Especially is it necessary that it should get home while the wind still continues to blow in the same direction, otherwise its landmarks will be all in confusion. One other difficulty: suppose the dog to have got into the fragrance of the hay-field, which is perhaps forty acres in extent, how is it to find the dung-hill at the north-west corner? particularly if the wind be blowing the wrong way. Is it to scour round the ill-defined outskirts of the perfume until it comes on the ill smell of the dung-hill? If we try to conceive in terms of vision (we can make nothing of it from our experiences of smell) such a memory of smells as the dog is supposed capable of acquiring, we must represent to ourselves the sensations of being carried through a series of differently coloured mists, which, while they prevent us from seeing objects, blend and shade into one another. In such a case, though we might remember that the red came after the yellow, how, having got into the red, should we know in what direction the yellow might be found? These are among the difficulties that have not, it appears to us, been sufficiently considered by Mr. Wallace and Prof. Robertson.

But what are the facts to be explained? Such home-journeys of dogs as might, by a stretch of imagination, or perhaps more correctly, want of imagination, seem to be accounted for by the smell-hypothesis, rest only on a rather loose kind of evidence, which can be adduced quite as abundantly in support of performances to which this explanation can be in no way applicable. In returning home do dogs "follow the identical route" by which they were taken away? There is no evidence even of the second-hand, loose, hearsay description, that this ever happened in a single instance.* The general impression, on the contrary, is that they despise the windings of rivers, turnpikes, and railways, and make for their destination by the most direct route. For example, and to add one more to the thousands of stories, we may mention that since we sat down to write we have received a letter from a gentleman telling us that about fifty years ago his paternal grandfather, living at Quorn, near Derby, sent two hounds by coach to his maternal grandfather living at Liverpool. Two or three days after their arrival they absconded together; inquiries were set on foot, and it is said they were seen swimming the Mersey at a point a little above Liverpool, where the river is of great width. They could be traced no farther, but after some time they made their appearance at Quorn, "foot-sore and in bad condition." Again, sheep, pigeons, and other animals that have not the miraculous scent of the dog, are believed on as good authority to find their way home through strange regions and from equally long distances.

Alluding to this class of alleged facts, Mr. Spalding, in the February number of *Macmillan's Magazine*, ventured to favour the view that through all the turnings and windings of a long journey the creatures somehow retain a perception of the direction of the place from which they were taken, and he further ventured to think that a hint of a similar faculty is to be found in some men. In this connection the facts with regard to savages would be most valuable. What Mr. Darwin calls the "trifling fact," communicated in his letter of last week, namely that his horse, which had been sent from Kent, *viâ* Yarmouth, to Freshwater Bay, in the Isle of Wight, on the first day that Mr. Darwin rode him eastward, was very unwilling to return towards his stable, that every time Mr. Darwin slackened the reins "he turned sharply round and began to trot to the eastward by a little north, which was nearly in the direction of his home in Kent;" this observation, together with the circumstance that with the fact before his eyes, Mr. Darwin's "impression was that he somehow knew the direction whence he had been brought," appears to us very important indeed. In the present state of our knowledge of the subject a few such "trifling facts" are worth more than many volumes of ingenious speculation.

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* See letter of "J. T." p. 384. We have other letters to follow.

We come now to the more weighty question which formed the subject of Mr. Darwin's first letter. Is it probable that instincts have any other origin than transmission by inheritance of acquisitions resulting from what we call individual experience? We are here at the very outside edge of human knowledge, in a region where no prudent person would venture to speak with confidence. Indeed the mode of origin recognised in the question still appears a "wild theory" to such respectable representatives of educated opinion as the *Spectator*. Had it been our good fortune to know as matter of certain history that the well-marked instinctive antipathy towards butchers of the dog King and his descendants was originally produced by ill-treatment, we should have had evidence of the most positive and direct kind, that sometimes at least instincts do originate in this way. There seems no hope of getting such evidence in this particular case; and indeed it may well be that the instinct in question is much more ancient than Mr. Darwin seems inclined to suppose. It is however to be hoped that before long some lover of animals will try his hand at actually producing a new instinct. But while Mr. Darwin regards it as probable that most instincts are examples of inherited experience, he thinks it "almost certain that many of the most wonderful instincts have been acquired independently of habit, through the preservation of useful variations of pre-existing instincts. Other instincts may have arisen suddenly in an individual, and then been transmitted to its offspring, independently both of selection and serviceable experience, though subsequently strengthened by habit. The tumbler-pigeon is a case in point, for no one would have thought of teaching a pigeon to turn head over heels in the air; and until some bird exhibited a tendency in this direction, there could have been no selection." The authority of Mr. Spencer may be adduced in support of Mr. Darwin's position. He speaks of "the natural selection of *incidental* variations," and of feelings that cannot be referred to "the inherited effects of experiences." Nevertheless, let us look closely at this matter. Will Mr. Darwin's view bear to be stated in such a way as to express more than the fact that in a great many instances we cannot conceive how the instincts originated? Will it bear to be put in this form: that it is almost certain that many of the most wonderful instincts had their origin in useful variations or sudden conjunctions of psychical states of such a character as could not by possibility have any relation to the experiences either of the individual itself or of its ancestry? Anything short of this will, it seems to us, scarcely amount to the contention that instincts have a mode of origin distinct from experience and heredity. That some other factor of unknown power may work along with experience and heredity in producing instincts, we are not in a position to deny. But still less are we in a position to say that there is such a factor, or what that factor is, or to admit that it ever operates independently of experience and heredity. We do not know how the tumbling of the tumbler pigeon began. But suppose we were certain that we had witnessed the very first performance of this kind, and saw that it arose suddenly and without any assignable cause: What then? How did the tumbling begin? To call it an incidental variation is but a way—and, because to some minds it looks like an explanation, a bad way—of stating our ignorance. But could we say so much as that it was in no way connected with experience and heredity? We think not. This tumbling is a fancy instinct, an outlet for the overflowing activity of a creature whose wants are all provided for without any exertion on its part. And if we had before us the evolutional history of the pigeon we might be able to point to some long obsolete instinct or useful action and say, behold, when on the wing, the superabundant energy of the creature has burst along the old long disused but not obliterated tracks, and see the strange result.

This is the direction in which we think it would not be unscientific to look for an explanation, should we ever have any such facts to explain. A similar line of remark might be followed with respect to what Mr. Darwin calls useful variations of pre-existing instincts. The question is, whence these variations? Further, just in proportion as these variations are slight, must it be difficult to say that they are not connected with experience—with the experience of the individual. In pursuing this inquiry we should doubtless come on the question, What is meant by experience? Everybody, it may be said, surely knows that. Perhaps. It is, we think, probable that the discovery might be made that we have not very clear and well-defined ideas as to the exact nature, extent, and limits of what we call individual experience. Of course we cannot now enter on such an inquiry.

SEPULCHRAL MONUMENTS OF CORNWALL *

II.

Nænia Cornubiæ. A descriptive essay, illustrative of the Sepulchres and Funereal Customs of the early Inhabitants of Cornwall. By W. Copeland Borlase, B.A., F.S.A. (London: Longmans; Truro: Netherton, 1872.)

MR. BORLASE, assisted by a party of friends, early in 1872, opened two barrows on the summit of one of the most commanding elevations in the district, about a quarter of a mile east of Trevelgue or Trevelga Cliff Castle, near St. Columb Minor. The most westerly is 250 ft. in circumference, 11 ft. high at the centre, and its greatest axis, having an east and west direction, is 100 ft. At a depth of 2 or 3 ft. from the surface, the entire substratum, to the amount of several hundred cart-loads, was burnt earth, as red and almost as fine as brickdust. Beneath it and towards the eastern side was a cairn of stones about 12 ft. in diameter, and 4 ft. high. Many of them had been brought from the neighbouring beach, and were blackened by fire. Under this lay a large spar stone, such as does not occur in the district, singularly flat for a stone of the kind, measuring 10·5 × 5·4 × 1·75 ft., on a level with the surrounding country, and covering a chamber 6·16 ft. long from N.W. to S.E., 2·5 ft. broad, and 2·75 ft. deep. Its sides were formed of four slate stones, 7 or 8 in. thick, and set on edge, on each of which the covering stone rested. The floor seemed to have been paved with slates, but they had been displaced, and portions of an unusually thick human skull were found below them.

The eastern or more conspicuous barrow was 80 ft. in diameter, 13 ft. high, and had a depression of 1·5 ft. at the summit. Immediately under the turf was a bed of stones, 3 ft. deep, and lying on a stratum of hard clay brought from a neighbouring valley. It contained a few human bones and ashes without any protection, and was 5 ft. deep. Under this was a second layer of stones, 3 ft. deep; and lower still an immense slate stone on a level with the natural soil, and covering a vault measuring 5·17 ft. long from N.W. to S.E., 2·8 ft. broad, and 2·25 ft. deep. The bottom was a pavement 6 in. deep, on which lay a human skeleton on its left side. The head was at the north-east corner nearly a foot from the end wall; the legs were bent at the knees, the arms stretched out so that the hands must have, at least, nearly touched the knees, and the body was contracted into a length of 4 feet.

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* Continued from p. 337.

Mr. Borlase holds that the Menhirs, or "Long Stones," of which there are many in various parts of the county, were sometimes tombstones merely, sometimes memorials of important events, and that they ranged from a romote antiquity far down into modern times.

In the hope of throwing some light on their origin the author recently examined the ground immediately around them. The Pridden Stone, close to the farm-house of Pridden, in the parish of Buryan, near Penzance, is an extremely rude mass of granite, 11·5 ft. above the ground, nearly 20 ft. in girth where broadest, and tapering towards the top. Below the natural level of the ground, a shallow pit, covered with a flat stone a foot in diameter, contained a few splinters of human bones, charred wood, and a layer of burnt brownish mould, the whole not sufficient to fill a quart pot.

On the farm of Tresvennech, in the parish of Paul, near Penzance, stands a granite menhir on the summit of elevated ground 11·5 ft. above the surface, and 4 ft. below. Though unhewn it is tolerably square at the angles, symmetrical, and perfectly upright. In 1840, a farmer, working near it, accidentally struck his tool against a horizontal flat stone 18 in. square, beneath which was a pit cut out of the clay soil, having its sides unprotected, and containing an urn 19·4 in. high, and 14·3 in. wide at the mouth. It stood mouth upwards, and contained the larger fragments of the calcined bones, and a molar tooth, of a human body; whilst the smaller pieces, together with wood ashes, were scattered throughout the pit. The urn was hand-made, and consisted of yellow clay found in the vicinity. Its interior was hard and black, but the exterior was not well baked. The handles were remarkably large and neatly put on, but differed in shape and size. A smaller urn, 5·5 in. high and 4 in. wide at the mouth, found 18 inches from the former, was also standing on its base, but without protection of any sort. It was filled with snuff-coloured powder.

The Sepulchral Mounds, or Barrows of Cornwall, whether of earth or stones, range from 15 to 100 ft. in diameter, and from 2 to 25 ft. in height. They resolve themselves into Cone, Bowl, Bell, Flat, and Ring barrows, but there is no instance of the Long, Druid, Egg, or Twin form, *i.e.* two surrounded by the same trench. The author recognises two pretty well-defined varieties of Ring-barrow:—1. Where the stones stand *on end*, at some distance from each other, and enclose only a piece of *level* ground. 2. Where the stones are set *on edge* (rarely *on end*) contiguous to each other, and enclose either a large rock, a few small mounds, or an area of uneven ground.

Of the first kind, there are four distinct examples within a circuit of eight miles in the Hundred of Penwith. Mr. Borlase is of opinion that all circles of *erect* stones owe their origin to the same design which attained its perfection in Stonehenge, and that the only question remaining is how far they can be regarded as sepulchral in their origin or use. He remarks that whatever may have been their *origin*, history and tradition seem to point rather to a civil than a religious *use* of them, and in confirmation quotes the "Iliad" (xviii. 503), a passage thus translated by Mr. Wright:—

> "Heralds the people checked. Elders meanwhile
> On polished stones in sacred circle sate."

The *Ring Barrows* of the second variety range from 10 to 100 ft. in diameter. The author has little doubt that they were originally sepulchral, and that they are cairns or barrows in an incomplete or demolished state.

At Trigganeris, in the parish of Sancreed, on the top of a hill, are two erect stones 17 ft. apart in a direction from N.N.W. to S.S.E., 7·3 ft. and 9 ft. high respectively. Nearly midway between them, but entirely on one side of a line joining their centres, a grave, 6 ft. long in an almost east and west direction, 3·25 broad, and about 5 ft. deep, was found cut with much precision in the natural clay. It contained nothing but the disturbed fine subsoil of the neighbourhood.

In 1818, a grave 8 ft. long, 3·5 broad, and 3 high, was found under a pile of stones 30 yards in diameter, near the "Cheesewring," in the parish of Linkinghorn, in East Cornwall. The bottom was one long flat stone; each side consisted of three stones, each end of one, and it had a cover of a single stone. Within it lay the remains of a human skeleton extended, having near the breast an earthen pot, containing, according to the workman who found it, a golden cup. The vessels were covered and protected with a flat stone 16 inches square, which leaned diagonally over them against the west wall of the grave. In this grave the following relics were also found, but subsequently lost:—a small piece of ornamental earthenware, a bronze spear head 10 in. long, a metallic rivet, as is supposed, and a few glass beads. The gold cup has been preserved, and is 3·75 in. high, 3·375 in. in diameter at the mouth, 2·5 ounces in weight, and its bullion value is 10*l.* It is perhaps worthy of remark that before the discovery of the cup there was a tradition in the neighbourhood of a "golden boat" having been dug up in a stone cairn near the Cheesewring.

It does not appear necessary to attach a nautical meaning to the word *boat*, for, unless we are in error, vessels for containing melted butter, sauce, &c., were formerly termed *boats* in Cornwall, as well as elsewhere.

Before quitting this cup it may be as well to add that we have elsewhere seen 1837 mentioned as the date of the discovery, instead of 1818, as given by Mr. Borlase.

Well-authenticated instances of inhumation are stated by the author to be extremely rare in Cornwall, and amongst these only two or three examples of the extended position actually occur, whilst only one of the contracted position can really be cited. He inclines to the opinion that the British copied the practice of cremation at a period not earlier than that of their contact with the Romans; and thinks that a very doubtful answer must be given to the question, "Have there been found in Cornwall any interments which can with some certainty be said to have preceded the practice of cremation?"

Mr. Borlase entirely dissents from the opinion that articles interred with the deceased had reference to any view of utility in the next world, or, in other words, that they are the result of a matured belief in a future state; but guards himself from being supposed to assert that such a belief was non-existent in the days of the barrows.

The large *sepulchral urns* are of two kinds. 1. *Vase-shaped* vessels from 10 to 20 inches high, ribbed round the upper part, sometimes ornamented with small indentations, but never with the chevron pattern. 2. *Barrel-shaped* vessels from 8 to 13·5 inches high, invariably ornamented with the chevron pattern.

Vessels differing from the foregoing in size only, and ranging from 4·5 to 6 inches in height, are very frequently found in Cornish barrows, and sometimes in close proximity to the large ones.

Mr. Borlase has compiled, from county histories, papers read to various societies, manuscripts of older antiquaries —especially Dr. Borlase—and his own note-book, a detailed account of explorations and discoveries in the Cornish tumuli, made at different periods, from Norden's account in 1584, of "an auntient buriall at Withiell," to his own researches at Pradannack in November 1871. It may be doubted whether any part of his interesting volume exceeds this in value; and we indulge the hope that others—not antiquaries only—may follow his example, and collect and record the researches that have been made in the departments to which they specially devote themselves, in the counties in which they reside. We should greatly like to linger over this chapter, but both time and space forbid us to do more—and this we do most cordially—than congratulate the author on the successes which have attended his explorations.

He devotes his last chapter to "The Age of the Monuments," and thinks that his discoveries justify the conclusion that some, at least, of the most typical of the interments might be brought within historic times, and assigned to the early centuries of the Christian era.

The facts which seem chiefly to delight him are those he discovered in 1863, on Morvah Hill, and of which he gives, as "most worthy," the following "second notice": —

> "Here was an instance of an interment in a cairn, where the body had been burnt on a central natural work surrounded by the usual ring of stones, the ashes placed in an urn of the usual chevron pattern, accompanied by the usual limpet and flint, protected by the usual Kist-Vaen, and finally covered in by the usual pile of stones. The whole arrangement, in short, being one of the most typical examples of the generality of barrows opened in the district. But here, in the very Kist itself, what should appear but late Roman coins of the third century! What is the most natural inference, then? That the coins must be thrown out of the question, because of the flint chip? or the whole structure referred at once to the Stone Age, thousands of years B.C., because it is encircled by large stones, or because the pottery is rude, and its ornamentation not curvilinear? Is it not rather the only fair course to admit at once that this interment, although possessing every characteristic of the so-called Stone Age, was placed here not earlier than the third century, A.D., that is, at the time when the coin was struck?" (pp. 263-4).

Being ignorant, perhaps, of some of the facts of the case, we do not presume to say that the author has not correctly interpreted his case, but as he seems resolved to ignore the question of secondary interments, which have undoubtedly taken place in many instances, and for aught that appears, may have occurred at Morvah, we hold *non proven* to be at present the only safe verdict.

We cannot take leave of Mr. Borlase's work without thanking him for the numerous well-executed illustrations with which it is enriched, and congratulating the publisher on the manner in which it has been got up.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

New Experiments on Abiogenesis

HAVING occupied myself for some time past with an experimental study of abiogenesis, I have followed with much interest the controversies on that question in recent numbers of NATURE, and beg leave therefore to state to the readers of this journal the results of my experiments, which form in my opinion a not unimportant contribution to the solution of the interesting problem.

I fully agree with Prof. Burdon Sanderson in the confirmation of Dr. Bastian's statements regarding the well-known turnip-and-cheese experiments. A turnip decoction of the specific gravity 1·011—1·016, filtered and boiled with cheese (0·25—0·5 grm. to 50 c.c.), filtered again and neutralised, then boiled for 10 minutes and hermetically sealed, is after 2—3 days' exposure to a temperature of 30° C. swarming with *Bacterium termo*. It is however to be remarked that a too great concentration of the solution hinders the evolution of the Bacteria; the volume of the liquid employed should therefore not be too small, otherwise the boiling for 10 minutes will render the solution too much concentrated. Perhaps the negative results recorded by some experimenters are to be explained in this way.

Both turnip-decoction and cheese are a mish-mash of substances for a great part ill-defined and imperfectly known. It would be desirable to substitute for these materials some other mixture of better defined ingredients.

Instead of cheese can be used peptone (0·2 grm. to 50 c.c.) with the same result. The peptone is obtained by digestion of egg-albumen with artificial gastric juice, subsequently isolated and purified by repeated precipitation with alcohol.

In searching for a substitute for the turnip-decoction I found it available not to use the hermetically sealed vessels, but to experiment with free admittance of air. The recent explorations of Cohn, Burdon Sanderson, and Rindfleisch have shown that the germs of Bacteria are but sparingly present in common air, but notwithstanding it is a matter of course that in these experiments no other but perfectly filtered air can be admitted. After many trials the following mode of experiment was finally adopted.

I prepared a solution of the mineral salts, that are according to Cohn indispensable to the nutrition of Bacteria, viz. 1 grm. potassium nitrate, 1 grm. magnesium sulphate, 0·2 grm. calcium phosphate to 500 c.c. distilled water. (This mixture does not quite agree with the solution employed by Cohn. For various reasons, which will be stated elsewhere in a more extensive report of my experiments, I preferred this modification.) In 100 c.c. of this liquid were dissolved 2·5 grms. grape-sugar and 0·4 grm. peptone. About 50 c.c. of this solution was poured into a glass flask holding about 100 c.c. The mouth of this flask was beforehand polished flat, and a layer of hot molten asphalt laid on the flat brim. The liquid in the flask was then boiled for ten minutes over an ordinary Argand burner. The excessive frothing of the boiling liquid is easily prevented by using a small flame, and carefully regulating it when the froth is on the point of coming up, yet without allowing the liquid to cease boiling. The ten minutes are reckoned from the moment the liquid begins to bubble freely.

The remarks of Dr. W. Roberts (NATURE, Feb. 20, p. 302) do therefore not apply to these experiments. Moreover, I observed frequently the temperature in the mouth of the flask, and found it always to be between 95° and 100° C. Therefore no part of the flask escaped the full effect of the germ-destroying heat.

While the boiling continued, a heated piece of unglazed flat earthenware tile was then pressed on the mouth of the flask; the solidified asphalt melted, and the piece of tile adhered, after cooling, firmly to the mouth of the flask. No air could then penetrate to the interior, except through the pores of the closing tile. The tile was 7 millimetres thick.

The previous heating of the tile is necessary, not only for melting the asphalt, but also for destroying the germs which possibly may adhere to the tile itself. This heating is effected in a Bunsen's burner, and raises the temperature of the tile to such an extent that a tuft of cotton-wool is scorched brown when pressed against it. The tile should not be too hot when it comes on the asphalt, lest the fumes arising from the decomposition of the asphalt should spread to the interior of the flask, and hinder the production of Bacteria.

The flasks prepared in this way were then exposed in a water bath to a temperature of 30—35° C. After two or three days the liquid was very turbid, very often a thick pellicle appeared on the surface, and flocky masses were swimming in the solution. The closing tile was then removed by melting the asphalt, and the microscopic examination showed myriads of *Bacterium termo* in lively motion, while the pellicle and the flocky masses consisted also of these organisms. *Micrococcus crepusculum* and *Vibrio serpens* were often present, but *B. termo* predominated. (The Bacteria were determined after Cohn's classification. "Beiträge zur Biologie der Pflanzen, II.")

The experiment conducted in this way yields always a positive result. Now three things are possible:—

1. The materials employed originally contained germs of Bacteria, which have simply developed themselves.

2. During the experiment germs have penetrated into the interior of the flasks.

3. The Bacteria have originated *de novo* in the liquid.

The first explanation is not admissible. For control-solutions treated exactly in the same manner, but composed in other proportions, remained under the same conditions perfectly free from Bacteria. These solutions were—

a. 100 c. c. of the above-named salt solution + 1 grm. ammonium-tartrate + 1 grm. grape-sugar.

b. 100 c. c. of the salt-solution + 1 grm. ammonium-tartrate + 0·2 grm. peptone.

Both these liquids are eminently suited to the nutrition and growth of Bacteria. That they nevertheless remained pure from these organisms proves that *none of the materials employed contained germs capable of resisting for ten minutes a temperature of* 100° C.

The second explanation is equally inadmissible. To prove this directly 1 grm. ammonium-tartrate was dissolved in 100 c.c. of the salt solution. This liquid was equally divided in two flasks, A and B. To A was added a trace of air-dust, collected in a little room where putrefying liquids were often standing, and then the flask was closed with a piece of tile in the above-described manner. B was boiled and closed as usual; but on the upper surface of the closing tile a considerable quantity of the same dust was loosely strewn. After twenty-four hours A becomes turbid, and swarms on the third day with Bacteria; B is on the eighth day still perfectly clear, and is then no longer examined. The conclusion is obvious: no germs of Bacteria do pass through the pores of the tile.

The only remaining explanation, is, in my opinion, this: under the above-described circumstances, Bacteria can arise without pre-existing germs. Not in any single case have I seen any other organisms than Bacteria—never fungi.

A certain concentration of the liquid is an important desideratum in these experiments. A specific gravity of about 1·012 is the most favourable. Greater dilution is a hindrance as well as greater concentration—at least when the above-named materials are employed. It is, however, not absolutely necessary to employ grape-sugar for raising the specific gravity up to 1·012. Common salt can do this just as well. Thus the following mixture is equally sufficient for generating Bacteria:—100 c.c. of the above-named salt solution, 2 grm. common salt, 0·2 grm. grape-sugar, 0·4 grm. peptone.

The first thing to be done now is to substitute for the grape-sugar and the peptone less complicated bodies. My experiments have been continued with this purpose.

This brief abstract may suffice for the moment. Shortly a more detailed communication and discussion will appear in one of the special journals. D. HUIZINGA,

Professor of Physiology at the University of Groningen

Groningen, March 15

The Janssen-Lockyer Method

SINCE my letter which appeared in NATURE of February 20 there has been a letter from Dr. Huggins (also in NATURE, February 27, p. 320), and I see that Mr. Richard A. Proctor has likewise published a letter in the *English Mechanic* of March 7.

With respect to the former of these communications I have but one remark to make. I was ignorant that the domestic bereavement to which Dr. Huggins alludes occurred at the time when the eclipse reports from India reached this country. This circumstance undoubtedly explains why Dr. Huggins did not sooner make the observation alluded to; and had I known the coincidence in point of time between these two events I should not have made the remark to which he refers.

Mr. Proctor's letter certainly surprises me, especially as coming from one who holds a prominent official position in the chief astronomical society of this country.

1. In the first place I cannot understand what Mr. Proctor means when he says with allusion to the question proposed by Mr. Lockyer in his preliminary paper of 1866—"I have always judged from the form of the query that, as he now mentions, Dr. Stewart had suggested its wording." If Mr. Proctor will refer to my letter in NATURE of February 20 he will find it stated that I advised Mr. Lockyer to introduce his views in the shape of a question, which he accordingly did. The wording was Mr. Lockyer's own, being the result of his own cogitations on the subject, and all that I did was to suggest the putting of it in the form of a question.

2. Nor can I understand what Mr. Proctor means when he says—"I can admit very readily that Mr. Lockyer clearly recognised the principle of the method for spectroscopically studying the prominences when he asked the query. I do not indeed see how any person at all familiar with spectroscopic analysis could have failed to do so, after reading Dr. Huggins' account of his observations of T Coronæ."

When Mr. Lockyer suggested the application of the spectroscope to the sun's red flames he knew, no doubt, and made use of his knowledge, that in white solar light the spectrum is scattered, while in light from incandescent gases it is not; but his information on these points was not surely derived from Mr. Huggins. Was not Newton the first to show that a slit of white light is dispersed by refraction into a broad band or ribbon? I do not know whether Newton ever clearly enunciated that in consequence of this dispersion the ribbon was less luminous than the slit. Perhaps he thought that this was sufficiently understood, but at any rate he who after Newton first made this announcement cannot be said to have made a very startling discovery. I have the highest respect for the brilliant discoveries of Dr. Huggins, but I am quite sure that he does not claim as one of these the statement that "when the feeble light of a nebula is dispersed into a spectrum consisting of light of all refrangibilities, the spectrum is extremely faint."

In like manner the man of science who first showed that incandescent gases give out only a few spectral lines made a great discovery; while he who after this discovery first announced that such light will not be weakened by dispersion can hardly be said to have made a discovery at all.

Now these two discoveries of two different kinds of spectra have been most prolific. Swan has used them; Kirchhoff has used them in certain experiments of his in which the conditions were probably very similar to those in T Coronæ, and after Kirchhoff, Huggins, and after Huggins, Lockyer. Each of these and many more have applied those well-known principles in many ways, none of the observers claiming the principles, but each one claiming his own application, being at the same time perfectly willing to acknowledge his neighbour's just claims. For instance, Dr. Huggins says—"To Mr. Lockyer is due the first publication of the idea of the possibility of applying the spectroscope to observe the red flames in sunshine." Now this is precisely the state of the case, and I need not say anything more.

3. Then as to the advice to Mr. Lockyer to put his suggestion in the shape of a query, it ought to be remarked that it was a

preliminary paper, and that Mr. Lockyer intended to follow up and did follow up his suggestion with the requisite observations. But at that time neither Mr. Lockyer nor myself knew to what extent the spectroscope would throw light upon these red flames. What service I did was in stating my opinion that those red flames were probably gases, while the suggestion as to how to detect them was due to Mr. Lockyer. Had the red flames proved to be solid particles, the spectroscope would have afforded only meagre negative evidence of their existence.

Our ignorance on this point suggested to us the propriety of a query. It was only in this respect that the query was ambiguous, that is to say there was no doubt that the method suggested by Mr. Lockyer would throw a great deal of light upon the red flames if they proved to be gaseous, but the only doubt in our minds was whether or not they were gaseous.

4. I have tried as well as I can in justice to both of us, to remember and reproduce what took place in the conversation in 1866 between Mr. Lockyer and myself, and to show the reasons for the form in which Mr. Lockyer's suggestion was put. Probably Mr. Huggins announced it afterwards in a more complete form, and probably it has since been announced in a yet more clear and complete form, if this be possible. For we know that as a rule discoverers and inventors have no great power of expression, and if the prize is to be given for the clearest possible utterance of a truth, it will be very seldom won by the discoverer, but will very frequently be obtained by the popular writer. Nevertheless I fail to see that Mr. Lockyer's original query was at all ambiguous in the sense that Mr. Proctor suggests. How, I should like to know (adopting the words of the query), could the spectroscope afford us evidence of the existence of the "red flames at other times than those of a total eclipse, unless by dispersing the reflected light."

5. Mr. Proctor asks, To what end are we to inquire whether Mr. Lockyer would or would not have detected the lines without the information derived from the eclipse observations? As far as I can understand the question I quite agree with Mr. Proctor. I do not think the inquiry ought ever to have been made. When, however, it was suggested that Mr. Lockyer derived aid from the Indian observations it was surely allowable for him to deny the imputation.

6. I have sometimes thought that discussions too frequently arise from the attempt to compare together the labours of different men, when all that is necessary is a statement of facts and dates. It is a matter of fact that the Indian observers at a particular date and under particular circumstances, made certain observations and derived certain results. It is likewise a matter of fact that Mr. Lockyer, at a date slightly later and under certain other circumstances, made observations of another kind, from which he also derived certain results. Different minds are differently constituted; one will think more of the Indian observations, another of those of Mr. Lockyer. But why should the two be compared together, unless some good object is to be gained by the comparison?

7. Now I cannot see why Mr. Proctor in his letter should have made the comparison at all, but since he has done so, I must be allowed to object to his method of making it. "Surely," he says, "on this matter we must assign Mr. Lockyer only the credit arising from the fact that, possessing an instrument which made the work child's play, he saw the lines by the method described by Huggins nine months before in detail, and depending on a principle which Huggins had stated fully two years and nine months before." I have already endeavoured to dispose of the latter part of the statement, and indeed Mr. Huggins has disposed of it himself; but with regard to the first part of it, I conceive that the possession of an instrument which made the work child's play, forms one element of the credit due to Mr. Lockyer. At first his instrument was defective and unable to do what he wished, but his conviction that something was to be made out of the sun, if examined by a powerful spectroscope, was so strong, that after much delay on the part of the optician employed, and sundry other discouragements, he at last procured for himself an instrument with which he saw the red flames at the very first trial.

8. I should not have alluded to the concluding paragraphs of Mr. Proctor's letter were it not written by one who holds a high official position in the Royal Astronomical Society. To my mind it is most deplorable that the secretary of this society should conceive himself at liberty to make in a public journal unsupported statements reflecting discreditably upon a distinguished member of that society. It is bad enough when two private men of science abuse each other, but it is not to be tolerated when a high official of a society of standing descends into the arena. If he insists upon doing so it is surely not unreasonable to request that he will in the first place divest himself of his robes of office.

For my own part I have thought that Mr. Lockyer has attached only too much importance to the little help I gave him when we conversed together in 1866.

BALFOUR STEWART

Mr. Mallet's Theory of Volcanic Energy

WILL you allow me to make a few remarks upon Mr. David Forbes's critique, which has but just now met my eye, though published in NATURE of February 6 last, upon my translation of Prof. Palmieri's "Incendio Vesuviano," and more especially upon that gentleman's animadversions upon my views as to "the true nature and origin of volcanic heat and energy," a brief and incomplete account of which I have given in the "introductory sketch" prefaced by me to that translation.

Mr. Forbes commences (p. 260) with an important error as to a matter of fact, by referring to "Mr. Mallet's Dynamical Theory of Volcanic Energy," as published in the Proceedings of the Royal Society for 1872.

My paper as above was read in abstract only in June last to the Royal Society, and being reserved for probable publication in the Phil. Trans., nothing but the most meagre and incomplete abstract has appeared in the Proceedings of the Royal Society.

I have given a somewhat fuller, but still most incomplete, account of it in my "introductory sketch" above referred to. My paper, and the full statement of my views, with the proofs which give them validity, have thus as yet never been published at all, nor even verbally stated publicly, the paper being still—after eight months, I regret to say—in the hands of the referees.

When published—as the paper in some form will no doubt be—Mr. Forbes will find that his objections—so far as I can gather anything tangible from their statement in NATURE—have been anticipated, and I believe completely answered, in my paper, along with others, better founded, because based on fact, which, as it appears to me, Mr. Forbes's objections are not.

Mr. Forbes uses "theory" and "hypothesis" as though quite the same (p. 260). My hypothesis is simply undeniable, being no more than that our globe is a terr-aqueous planet subject to secular refrigeration; and upon that hypothesis I have built up my theory, that the evolution of volcanic heat is a necessary result, upon acknowledged physical laws of such refrigeration; and that from such heat so evolved—as the *primum mobile*—come in train all the other recognised volcanic phenomena: chemical, as in the fusion and combination of the constituents of rocks into definite and indefinite compounds, decomposition of many solid, liquid, and gaseous bodies; mechanical in the elevation and throwing out at volcanic vents of all or any of these: water, air, and the chemical elements known to exist in the crust of our earth being the only conditions needed, in addition to heat, to account for all that we know as to volcanic phenomena, as now active in our planet.

I claim to have been the first to apply "measure, number, and weight" to volcanic theory; and when men of science generally shall have had access to my statements, I trust it will be admitted that I have not shrunk from rigidly testing by calculation the adequacy of the source I assign for volcanic heat, nor of the mechanism through which its subsequent effects are produced, as seen in volcanic phenomena. I am at the disadvantage that I cannot expect to cumber your pages by reference to those proofs—they are the less necessary here, however—inasmuch as my reviewer, though affecting to discredit the adequacy of the origin I assign for the "quantity of heat requisite to melt up such vast volumes of rock matter as are known to proceed from volcanoes," does not present a single argument against it, and, in fact, appears unwillingly to admit it. He however proceeds to object generally to my views by the following statements. They are so vague and inconsecutive that, as far as possible, I shall endeavour to condense them in his own words:—"Admitting that the conversion of the mechanical *force into heat* is sufficient to effect the melting part of the operation, there remains the greater difficulty of explaining the chemical and mineralogical features which characterise volcanic phenomena. For although mechanical *force* is admitted to be convertible into its equivalent heat, which in turn may 'cause' chemical action, still no such forces, alone or in combination, can transmute one chemical element into another, or give rise to products having at all times a definite chemical and mineralogical constitution, out of the incongruous materials likely to be met with" in the crust of our globe.

"Our knowledge of the mineral characters of that crust does not admit the supposition that the substance of the rocks occurring in so many different parts of the world could in all or in any but solitary instances when fused by mere heat afford products identical with those of known volcanoes.

"Volcanic products, no matter from what part of the world derived, are *identical in chemical or mineralogical constitution*; a result which indicates that they must be derived from some one common source, and not mere local accidents, as Mr. Mallet's *hypothesis* would require us to assume.

"For these and other reasons [none of which are suggested] it does not seem probable that this *hypothesis* will receive the adherence of either chemist, mineralogist, or geologist." The italics are mine.

Now I cannot help remarking that Mr. Forbes shows his very slender acquaintance with the vast subject he so jejunely disposes of, by the very language he employs; *force* cannot be converted into heat, equivalent or otherwise; *work*, *i.e.* pressure producing motion, is transformable into heat, and every other known form of energy. But passing this as well as the reiterated confusion between hypothesis and theory, I ask, is it a fact as stated, that volcanic products whencesoever derived, in time and in space over the whole globe, are *identical in chemical or mineralogical constitution*. I affirm unhesitatingly that it is not a fact, and I appeal for confirmation of my denial to every authoritative work on the subject, and to every well-informed mineralogical chemist.

Are the ancient basalts and trachytes identical with the modern ones, or with each other in different localities? Are the modern lavas of extinct or active volcanoes all over the world, or even at closely adjacent places, all identical? Are the highly liquid lavas of Otaheite, producing "Pele's hair," the same with the terrane lavas of Etna? Are the trachytes of Auvergne—the *Pierre de Volvic* so well known to French engineers, the same as those of Pozzuoli and of the Rhine? Are the products of the same volcanic basin ever identical—say the pumices and obsidians of Pouza, Ischia, and Lipari—with the innumerable varieties of lava of the same localities, and of the phlegræan fields and of Sicily? Are even the lavas of the same cone and during the same eruption always identical? Palmieri in the very report Mr. Forbes reviews, says (p. 105), "The *qualitative* analysis of the (Vesuvian) lavas always presents the same elements," with certain exceptions; "but with respect to *quantitative* analysis, two specimens of the same lava have their constituents in different proportion." Nay more, are even the crystallised minerals of definite chemical constitution, as segregated from the lava pastes or glasses, *identical* all over the world, or even for any one cone, or often for any one eruption? No, there is just that general similarity in the constitution of volcanic products that we should expect to result from the heating more or less, or the fusion together of the "incongruous" beds, siliceous, aluminous, magnesian, calcarious, mixed more or less with metallic oxides, or other compounds, and often with carbon, boron, and other elements all variously superposed or mixed, which constitute the known crust of our globe, along with most probably the materials of crystalline or other rocks below, the nature of which we can but guess at. There is just the same general similarity that is seen in the slags of all metallurgic furnaces, which fuse very similar materials to the volcano, but with a preponderance of some metal also. Are the slags of the same iron blast furnace *identical* even for any two tappings, though the working and charge is apparently the same? No, and for very obvious reasons. Are even the crystallised minerals that segregate from these slags, from the same furnace assumed, worked in the same way, always identical?

If Mr. Forbes will study Von Waltershausen's early and able work on Lavas, one scarcely known in this country, Zirkel's "Petrographie," Senft's "Kristallmischen Felsgemengtheile," and above all Blum's "Handbuch der Lithologie," amongst many others he will soon see how very baseless is the supposed fact on which he so confidently relies for his objection to my origin of volcanic heat.

But let us for a moment assume that it were a fact that all the volcanic products all over the world, and for all geologic periods, were "identical in chemical and mineralogical constitution," how would that form any relevant objections to the thermo-dynamic origination which I have assigned to volcanic *heat*. Or how would it help the old notion of a very thin crust and a universal molten ocean beneath, or the exploded one, that chemical action produces the heat, and the heat produces the chemical action.

Whatever be the origin assigned to the heat, it is within or below the heterogeneous solid crust of 10 to 40 miles thick, which we are acquainted with. More or less of that heterogeneous crust must be melted up, along with the material assumed everywhere the same of the molten ocean coming up through it from beneath.

It is proveable on merely hydrostatic grounds that the mass of such a molten ocean, if of materials such as are found in our earth's crust, could not be everywhere and in all latitudes identical in construction; but were it so, it must get contaminated and modified in passing through and melting the "incongruous" ducts of the crust bringing it to the surface.

On the other hand absolute identity everywhere in the volcanic products, did it exist, could prove nothing in favour of a universal ocean of ready-made lava as the source or origin of volcanic heat; but only that whatever might be the origin of that heat it was so circumstanced as to act on materials everywhere the same, and that these reached our surface without any action or mixture with the "incongruous" crust through which the molten matter came. There is just the same room for "local accident" in one case as in the other. A reviewer should at least be sure of his facts before he brings them into hostile array.

But again, what are the grounds for the assumption that according to my views, volcanic products of whatever sort are "the result of fusion by *mere* heat." I point out a true cosmical and thermo-dynamic origin for the heat itself, but under the actual conditions of volcanic foci and ducts, chemical actions must take place, as a consequence of the heat, and together vary the results of the reactions of all the materials present in fusibility, in aggregation, in their solid, liquid, or gaseous states, in their molecular conditions and in their chemical and crystallogenic combinations. This objection as little applies to anything I have written, as the irrelevant suggestion, that the transformation of energy "cannot transmute one chemical element into another."

I believe this disposes of whatever is tangible or worth remark in Mr. Forbes' strictures.

He ends, however, in a manner unusual I should think for an unbiassed reviewer, by uttering a sweeping prophecy, "for the reasons given [and above repeated], and others not brought forward, it is not probable that this hypothesis [*i.e.* my theory of volcanic energy] will receive the adherence of either chemist, mineralogist, or geologist." Prophecies, especially as to matters of science, are dangerous things, and the prophets would do well to rule by Swift's advice, as to utterances of another class, and never record one that can be falsified within a short time. It so happens that I am able already to explode Mr. Forbes's. Writing to me under date of Dec. 24 last (1872), Dr. Haughton, Professor of Geology of the University of Dublin, says—"I gave two lectures during the last term (Michaelmas) which were attended by many of the fellows, in which I developed your theory of volcanoes and gave you full credit. The whole system hangs well together and must make progress." Prof. Dana (in noticing this same book which Mr. Forbes so uncompromisingly condemns), as editor of the *American Journal of Science*, for the month of February, 1873, at p. 151, says: "His paper is the most important contribution to this department of geological dynamics that has ever been brought forward, and the work above-mentioned [*i.e.* Trans. of Palmieri] is by his share of it more than doubled in value." In a letter to me, Feb. 11, 1873, Prof. Dana says: "Your views throw great light on a hitherto mysterious department of geological science, and I have no doubt that they will speedily gain general acceptance."

I could add like expressions from some others. Now both Haughton and Dana are at once chemists, mineralogists, and geologists. They are both, also, sound physicists and mathematicians. So this prophecy is already falsified, and I am consoled with the notion that my theory of the nature and origin of volcanic energy may survive the unreserved condemnation to which Mr. Forbes has sentenced it, on the grounds that I have above examined, and without his ever having had access to the paper itself criticised by him. I might refute, too, some criticism on the book itself, which I cannot avoid calling unfair, and also not founded on fact. It is not true, for example, that the first forty-six pages of my introductory sketch "are but an abstract of my previously published investigations into the theory of earthquakes" (p. 260). The reviewer may not have been able or not taken the trouble to distinguish the old from the new; but as a fact, the greater part of those forty-six pages is of matter never before published.

So also it is scarcely candid to object that "no reference is found to any of the Continental men of science who have done so much for terrestrial vulcanicity," which is contrary to the fact, for I have referred by name or by their labours to the few who have in any way advanced our knowledge as to the nature and origin of *volcanic heat*, without noticing that within that scope only was I by space obliged to confine myself, as stated in pp. 48, 49, 54, 76, &c.; the phenomena occurring at volcanic vents, which have chiefly engaged the attention of Continental and all other volcanic authors being avowedly outside my limits, and, I might add, but too often of secondary importance.

The nomenclature generally of my "Translation of Palmieri" is said to be objectionable, because such terms as sulphide of potass and terrochloride of ammonia are encountered. I have looked through the pages since without being able to discover these dreadful terms. However I am ready to take the reviewer's word that such a slip in proof correcting may be found in some place, and I humbly bow to such microscopic, profound, and valuable criticism, though, as stated, the conclusion is a good deal wider than its premises. ROBERT MALLET

Enmore, The Grove, S.W., March 5

Effect of Resistance in modifying Spectra

IN a review of M. Guillemin's work "The Forces of Nature" which appeared in last week's *Athenæum*, the following reference, by M. Guillemin, to the experiments of M. Mitscherlich is quoted: "Suivant ce physicien il arrive que la presence de certaines substances dans une flame a pour effet d'empecher de se produire les spectres des autres substances, d'enteindre leurs raies principales." The English editor adds that the effect "may probably be explained by the observations of Frankland and Lockyer."

In relation to this subject of the extinction of the bands of one metal by another, you will perhaps permit me to quote a paragraph from one of the lectures which I have recently had the honour of delivering in the United States. The arcs of thallium and silver had just been compared, and their similarity of colour pointed out. The power of prismatic analysis to show that, notwithstanding the apparent identity of colour, the arcs really belonged to two different metals, was then demonstrated. The metals were afterwards subjected *together* to the action of the Voltaic current, and it was shown that the band of thallium fell midway between the two bands of silver. Hence the similarity of colour. The lecture then proceeds thus:—

"But you observe here another interesting fact. The thallium band is at first far brighter than the silver bands; indeed the latter have wonderfully degenerated since the bit of thallium was put in. The reason of this is worth knowing. It is the *resistance* offered to the passage of the electric current from carbon to carbon that calls forth the heating power of the current. If the resistance were materially lessened, the heat would be materially lessened; and if *all* resistance were abolished there would be no heat at all. Now thallium is a much more fusible and vaporisable metal than silver, and its presence facilitates the passage of the current to such a degree as to render it almost incompetent to vaporise the more refractory silver. But the thallium is gradually consumed; its vapour diminishes, the resistance consequently rises, until finally the silver bands are rendered as brilliant as at first."

In the spectra of mixed substances derived from the electric spark the action here referred to must come frequently into play. If neither the fact, nor its proposed explanation, be new, I would thank you to commit this document to your waste-paper basket. JOHN TYNDALL

Royal Institution, March 1873

Perception in the Lower Animals

THE theory of taking olfactory notes by the way, as suggested by Mr. Wallace in explanation of the faculty possessed by animals of finding their way home, seems to meet with general acceptance amongst your correspondents; yet it totally fails to account for those instances in which the animal finds its way back by quite a different route to that by which it was taken away.

A good example is given by "F. R. G. S.," in the last number of NATURE; the anecdote of his riding-horse, by Mr. Darwin, also seems to illustrate this point. In an article on the "Consciousness of Dogs," in the *Quarterly Review*, of last October, the following remarkable instance, amongst others, is mentioned on indisputable authority. A hound "was sent by Charles Cobbe, Esq., from Newbridge, county Dublin, to Moynalty, county Meath, and thence, long afterwards, conveyed to Dublin. The hound broke loose in Dublin, and the same morning made his way back to his old kennel at Newbridge, thus completing the third side of a triangle by a road he had never travelled in his life."

Now as Mr. Wallace's theory does not explain these and similar instances, it clearly cannot be received as a solution of the question. Moreover, not only does the faculty exist in other animals not remarkable for their sense of smell, but we find it in cases where this sense has nothing to do with it. Take, for example, the direct homeward flight of the carrier pigeon. Under the same head may be brought the migrations of birds and fishes, and the habits of the turtle, as mentioned by Mr. Darwin.

The writer in the *Quarterly* suggests a sense of the magnetic currents of the earth—a sort of internal mariner's compass in fact. But it is difficult to see how this could have helped the dog to find its way from Dublin to Newbridge, for instance, unless it was also able to consult a map so as to ascertain the relative position of the two places.

It seems then that the problem still remains unsolved. Either we must extend almost indefinitely the range of smell and sight; or, we must suppose the existence of some peculiar sense of the nature of which we are ignorant, which enables its possessor to retain, as F. R. G. S. expresses it, "a constant perception of the bearing of its old home." J. T.

Bath, March 17

POSSESSION ISLES

AS the idea of occupying Possession Islands as a station for observing the Transit of Venus has been lately propounded, I have been requested to communicate to NATURE the results as to its climate, which we have obtained in this office from the logs of H.M.S. *Erebus* and *Terror*, which we are now re-discussing with a view to publication.

Possession Isles are in lat. 71° 56′ S., long. 171° 7′ E. H.M.S. *Erebus* and *Terror* were within lat. 70° to 72⅓° S., and long. 170° to 175° E. from 10th to 17th January, 1841. During these eight days the mean height of the barometer was 29·143, mean temperature of the air 29°·7, and of the sea 30°·5; the wind was variable, but chiefly from S. and SSW., force 6; the weather was clear ten times, cloudy twenty times, overcast eighteen times, from forty-eight double sets of four-hourly observations, while snow was noted nine times, and squally weather ten times.

The ships were within the same area on 20th and 21st February, 1841; and, during these two days, the mean height of the barometer was 28·920 inches, mean temperature of the air 23°·5, of the sea 30°·1; wind WSW. to SE., force 9 to 5; the weather was cloudy and overcast.

In addition I am permitted to enclose a letter from Dr. Hooker, which he kindly sent me in reply to my inquiries as to his reminiscences of his visit to these inhospitable regions, and which he has allowed me to publish.

Meteorological Office ROBERT H. SCOTT

Letter from Dr. Hooker

Possession Island, or rather Possession *rock*, is in a very inaccessible position. The chance of landing a well-equipped party upon it when reached, and the prospect of its subsequent removal by ships, if landed on, is very small. In any case I feel little uncertainty as to what would be the fate of a party left there for the winter, and the prospect of their seeing the transit would be absolutely *nil*.

To reach it we "took the pack" January 3, 1841, and had not penetrated it till the 9th, aided at last by a furious gale. We then discovered South Victoria, and traced its coast from lat. 70¾° to lat. 78°, without finding a spot where it was possible to approach the shore. During the twenty-two days that we spent off that continent, we never effected a landing but twice, and then, with the greatest difficulty, on two small volcanic islets, without a particle of vegetation on them, of which one was Possession Island (Jan. 13), *a mere rock*. The ship was hove to two miles off; with the greatest risk a landing was effected, on a beach of large loose stones and stranded masses of ice. It was no sooner done than the recall flag was hoisted in the ships, which were reached just as a terrific fog came on, followed by a gale of wind; ten minutes more and all hands in the boats would have been lost, for the currents ran like sluices between the land, islets, and icebergs. So much for Possession Island. (Read Ross's account of the landing, i. 188, and especially the paragraph at p. 190.)

Take a glance at the meteorological registers in Ross's voyage for the month of January 1841, which was passed between S. lat. 66° 32′ and 78°. The mean temperature was 29°·02, max. 41°·5, min. 19°·5. It snowed on sixteen days; overcast, squally and misty was the usual weather, blue sky was rarely seen over more than a quarter of the heavens for a very few hours of the day, and for many days not seen at all.

In March between lat. 77° and 69½°, the mean temperature was 24°·28, max. 34°, min. 13°. Sky as in January.

In the following year our vessel went to the same seas. We "took the pack" December 17, and after being all but wrecked, penetrated it after fifty-six days of great peril, and proceeded to 78° S., never once seeing land.

During that January within 66° 32′, and 67° 21′ the mean temperature was 30°·46, max. 40°·5, min. 24°. It snowed on seventeen days, and we hardly ever saw blue sky.

In February between lat. 67° 18′ and 78° 12′, the mean temperature was 26°·68, max. 35°, min. 16°·5, and it snowed on twenty days. Blue sky was seen only on thirteen days. In 1842 the weather was worse than ever. In that year we tried to get south in the meridian a little east of Cape Horn, but never got beyond lat. 71½°, and then not till March 6th, having left the Falklands on the 18th December. In January of that year (1842) we were between lat. 63° 58′, and 64° 44′. The mean temperature was 30°·9, max. 45°, min. 23°·5. It snowed on sixteen days —sky as before.

February—between lat. 61° 37′ and 66° 01′. The mean temperature was 30°·50, max. 35°·5, min. 27°·5. It snowed on twenty-four days out of the twenty-eight! Blue sky was seen only on seven days, and this on six days over one-eighth of the sky, and on the 7th over one-fourth.

With such a midsummer climate I leave you to guess the position of a party in lat. 72°, cooped up through a winter on a rock a few yards long, covered with snow.

During the third year's cruise to the southward, Captain Crozier never once went to his cot, and we passed day and night with our hearts at the top of our throats.

The fact is, there is no summer or clear weather to be had, except by the rarest chance. For days and days we worked by Dead Reckoning alone. Storm, wind, and snow, are the prevalent summer phenomena. Still some seasons are not so bad as others, and Weddell got to 74½° in an open sea in the meridian where we barely reached 66°. (Signed) J. D. HOOKER

Royal Gardens, Kew, March 6

The following is the account of the landing alluded to by Dr. Hooker:—

"We found the shores of the mainland completely covered with ice projecting into the sea, and the heavy surf along its edge forbade any attempt to land upon it; a strong tide carried us rapidly along between this ice-bound coast and the islands amongst heavy masses of ice, so that our situation was, for some time most critical; for all the exertions our people could use were insufficient to stem the tide. But taking the advantage of a narrow opening that appeared in the ice, the boats were pushed through it, and we got into an eddy under the lee of the largest of the islands, and landed on a beach of large loose stones and stranded masses of ice. . . . . The island is composed entirely of igneous rocks, and only accessible on its western side. We saw not the smallest appearance of vegetation, but inconceivable myriads of penguins completely and densely covered the whole surface of the island, along the ledges of the precipices, and even to the summits of the hills, attacking us vigorously as we waded through their ranks, which, together with their loud coarse notes, and the insupportable stench from the deep bed of guano, which had been forming for ages, made us glad to get away again, after having loaded our boats with geological specimens and penguins. Owing to the heavy surf on the beach, we could not tell whether the water was ebbing or flowing; but there was a strong tide running to the south, between Possession Island and the mainland, and the *Terror* had some difficulty to avoid being carried by it against the land-ice. Future navigators should therefore be on their guard in approaching the coast at this place."

EARTHQUAKE WAVES

THE self-registering tide-gauges maintained by the United States Coast Survey at different points on the sea coast frequently exhibit, superimposed upon the tidal fluctuation, a succession of long waves, the origin of which is ascribed to distant earthquakes. In two notable instances, viz., the earthquake of Simoda in 1854, and that of Arica in 1868, the great ocean waves caused by the disturbance were distinctly registered in that way by the tide-gauges on the Pacific coast, and have been made use of for estimating the average depth along the lines of transmission. (See Coast Survey Reports for 1855, 1862, and 1869.)

Similar fluctuations were registered on the morning of November 17, 1872, shortly after local midnight, on the tide-gauge at North Haven, on the Fox Island, in Penobscot Bay, Maine. The fluctuations continued from midnight until nearly six o'clock in the morning, at somewhat irregular intervals of about seventeen minutes from crest to crest, with an average vertical range of nine inches, the greatest wave being at three o'clock, with a height of twenty inches.

No corresponding earthquake phenomena have come to the knowledge of the Coast Survey Office, and it is probable that if such was the case, the shock occurred somewhere under the Atlantic Ocean.

THE CHALLENGER EXPEDITION

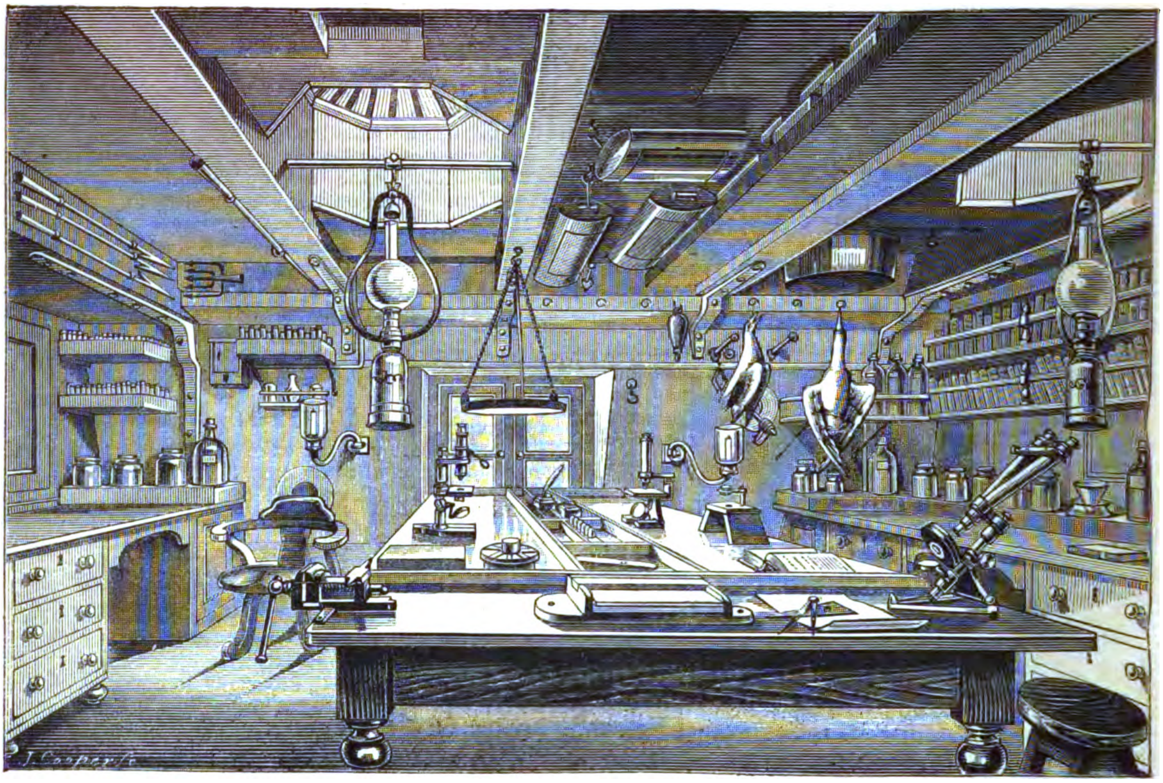
H.M.S. *Challenger* cast off from the jetty at Portsmouth at 11.30 A.M. on December 21, with a low barometer. A strong south-westerly breeze was blowing, and the drum up; so that, especially in a season like the present, the prospect was not promising for the first few weeks of her voyage round the world.

The result justified the drum, and for a week we were knocking about the mouth of the Channel, and the Bay of Biscay, making slow progress southwards. It was perhaps as well to get a good shaking at first. It showed at once where there was a screw loose, and gave a chance to tighten it up. A sharp cyclone which caught the ship on her way from Sheerness to Portsmouth had already tested pretty fully the stowing of the apparatus, and although the *Challenger* rolls considerably when she is put to it (over 35°), not a single instrument shifted, and not a glass was broken, either in the zoological workroom, or in the chemical laboratory. Just before we got to Lisbon the weather improved a little, and we got some soundings and took one or two trial hauls with the dredge.

After leaving Lisbon on January 12 the wind was again fresh, but between Lisbon and Gibraltar we made some important experiments, and found, among other things, that we could work easily and successfully with the common trawl down to 600 fathoms. I am now writing about 100 miles north of Madeira, and since leaving Gibraltar the weather, though at first breezy, has been on the whole fine. We have taken several successful navigative sounds at great depths, and we have trawled successfully at 2,125 fathoms, and recovered many interesting animal forms, several of them new to science, and others of extreme rarity and beauty. Still we must regard our work up to the present time as only tentative. The weather has been against us. It is altogether a new experiment to dredge from so large a ship, and it seems to present some special difficulties, or at all events to require some management. The weight of the ship is so great that there can be no "give and take" between it and the dredge, such as we have in the case of a smaller vessel. If there is any way on, the impulse to the dredge is irresistible, and seems to tend to jerk it off the ground. This difficulty can no doubt be met, but the only way of meeting it appears to be by using a length of rope greatly in excess of the depth—and having weights. A single dredging operation may thus occupy a great length of time, but in compensation we have the greater size and efficiency of this dredge. The few trials which we have already made have been all in the direction of improvement, and I have little doubt that under Captain Nares' skilful management what little difficulty is still felt will shortly disappear.

As I hope to contribute to NATURE from time to time a series of articles giving the results of our voyage, it may be well to commence by giving a sketch of the general scope of our operations, and the means and appliances at our disposal.

The *Challenger* is a spare-decked corvette of 2,000 tons displacement. This particular build gives her an immense advantage for her present purposes, as she has all the accommodation of a frigate, with the handiness and draught of water of a corvette. Sixteen of the eighteen 68-pounders which form the armament of the *Challenger* have been removed, and the main-deck is almost entirely set aside for the scientific work. The after-cabin is divided into two by a bulk-head, and the two little rooms thus formed—still gay with mirrors, and pictures, and new chintz, and bright with home faces—are allotted to Captain Nares and myself. The fore cabin, a handsome room, 30 ft. long by about 12 ft. wide, into which these private cabins open, the captain and I use as a sitting room, the port-end with its writing-table and work-table, and its book-cases packed with old home favourites, being appropriated to my use and that of my secretary Mr. Wild; while the captain has arrangements at the starboard end of the same kind. Two sets of cabins have been specially built on the after-part of the main-deck for this difficult part of the scientific work. On the port side a commodious zoological work-room is occupied by the naturalist of the civilian staff, while the chart room corresponds with it on the opposite side. Towards the middle of the main-deck on the port side there is a dark room and a working room, for the photographer, and on the starboard side Mr. Buchanan has his chemical and physical laboratory.

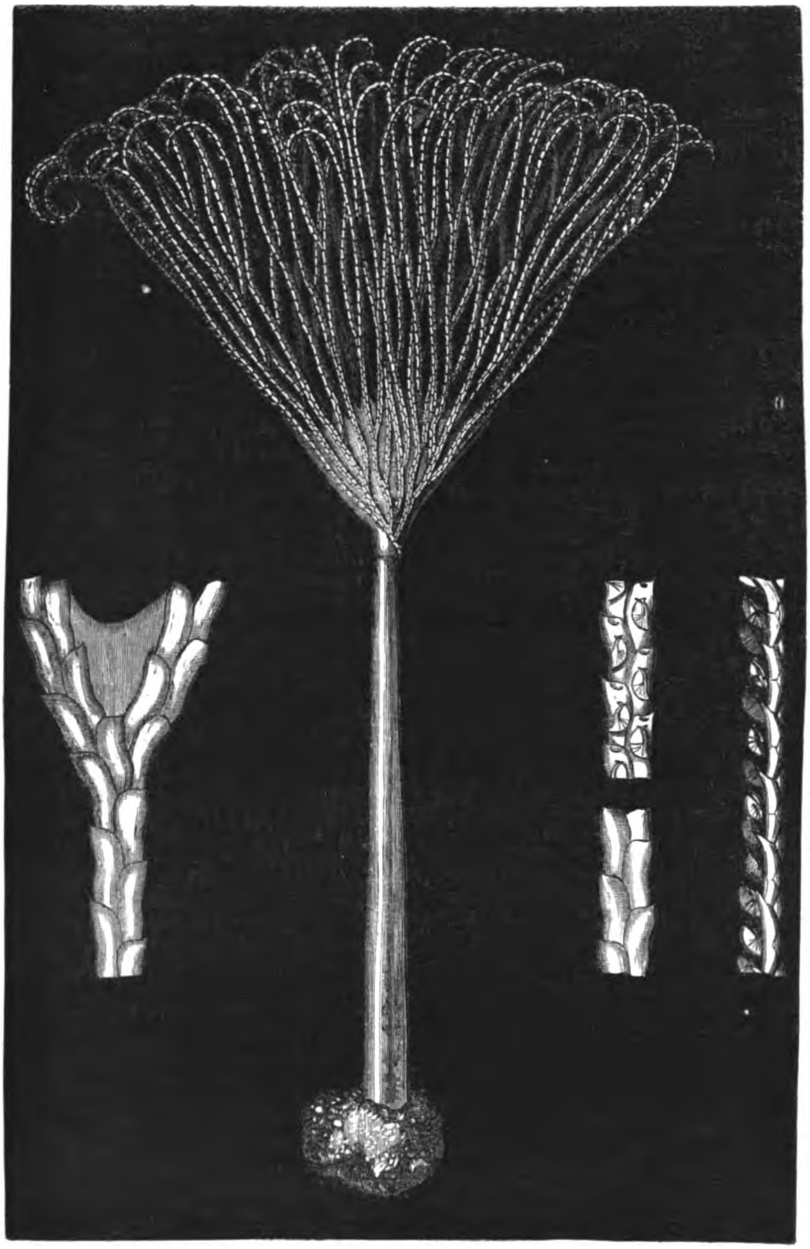


LABORATORY OF THE "CHALLENGER"

Nearly the whole of the fore-part of the main-deck is occupied by the dredging and sounding gear, Mr. Siemens's photometric and thermometric apparatus, and the more cumbrous of our machines, such as the hydraulic pump, the aquarium, and other very valuable articles, of which a detailed description will be given hereafter.

I feel justified in going even so far as to say that the arrangements for scientific work in the *Challenger* leave little or nothing to be wished for. Captain Nares and his officers not only do everything which care and skill can accomplish to further our objects, but, having naturally a certain advantage over the civilians in rough weather, they keep us up to the mark by the lively interest which they take in the success of our operations. There is a common mess in a large ward-room on the lower deck, and the civilians have to heartily thank the naval men for the frank courtesy with which they have received them into their fellowship.

Dredging and sounding are carried on from the main-yard. A strong pennant is attached by a hook to the cap, and then by a tackle to the end of this yard. A compound arrangement of fifty-five of "Hodges' accumulators" is hung to the pennant, and beneath it a block through which the dredge rope passes. This arrangement appears to answer better than the old one of dredging from a derrick.



NARESIA CYATHUS

For the first two or three hauls in very deep water off the coast of Portugal, the dredge came up filled with the usual "Atlantic ooze," tenacious and uniform throughout, and the work of hours in sifting gave the very smallest possible result. We were extremely anxious to get some idea of the general character of the fauna, and particularly of the distribution of the higher groups; and after various suggestions for modifications of the dredge it was proposed to try the ordinary trawl. We had a compact trawl with a 15 ft. beam on board, and we sent it down off Cape St. Vincent at a depth of 600 fathoms. The experiment looked hazardous, but to our great satisfaction this trawl came up all right, and contained, with many of the larger invertebrata, several fishes. Two of these belonged to the genus *Macrourus*, and another of large size was unknown to us, approaching in many respects the genus *Mugil*. All the fishes were in a peculiar condition from the expansion of the air contained in their bodies. On their relief from the extreme pressure, their eyes especially had a singular appearance, protruding like great globes from their heads.

After this first attempt we tried the trawl several times at depths of 1,090, 1,525, and finally 2,125 fathoms, and always with success.

Several fishes, most of them allied to *Macrourus*, were added to the list. Several decomposed crustaceans, and among the lower crustaceans at 1,090 fathoms, a gigantic amphipod, of the family Hyperina, allied to *Phronima*. The eyes of this creature are very remarkable, extending in two great facettio lobes over the whole of the anterior part of the cephalo thorax, like the eyes of *Aeglina* among Trilobites. This crustacean, which is three and a half inches in length, makes a splendid drawing, and reminds one of the old Eurypterids, is in process of description at the hands of Dr. von Willemoes Suhm.

Mollusca are very scarce in deep water, and our catches have hitherto been chiefly confined to such things as the species of *Nucula*, *Leda*, *Verticordia*, &c., familiar through the deep dredgings of the *Porcupine*. Among the molluscoids a haul in 1,525 fathoms gave us a lovely thing, a bryozoan forming, out of branches closely resembling those of *Accromarchis neritina*, a graceful cup, the bases of the branches united by a transparent stem between two and three inches high, like the barrel of a quill, or the stem of a claret glass. This genus, which presents a general character totally different from anything hitherto known among recent Bryozoa, I mean to dedicate to Captain Nares, as an early recognition of the confidence and esteem which he has already fully gained from the scientific staff. *Naresia cyathus* certainly recalls, in a most singular way, the Cambrian *Dictyonema*, a form which I had, however, hitherto been inclined to refer to the Hydrozoa.

The Echinoderms have yielded some exceedingly interesting species to the trawl; among them several examples of the beautiful little urchins, of which one specimen was taken by Count Pourtales, in the Straits of Florida, and described by Alexander Agassiz under the name of *Salenia varispina*. It is undoubtedly a true *Salenia*, and to an advocate of the doctrine of the "continuity of the chalk," it is pleasant to see in the flesh this little beauty, which has hitherto been reckoned among the lost tribes.

Among the star-fishes two species of the genus *Hymenastes* have occurred, and the ophiurids are well represented chiefly by large examples of several species of the genus *Ophiomusium*.

All the hauls of the trawl, down to 2,125 fathoms, have yielded many specimens of a singular Holothurid, of which a description will shortly be published by Mr. Moseley. The animal is of a rich violet colour. Like *Psolus*, it has a distinct ambulating surface, with a central double line of water-feet. The body cavity is small, but the perisom is represented by an enormously thick layer of jelly, which rises on either side of the middle line of the back into a series of rounded lobes, each perforated for the passage of an ambulacral tube and corresponding therefore with an ambulacral foot. The upper pair of vessels of the trivium send out series of leaf-like sacs, richly loaded with pigment, which fringe on either side the ambulatory disc, and appear to be chiefly concerned in the function of respiration.

Sea-peas and Gorgoniæ have occurred frequently, always remarkable for their brilliant phosphorescence. Captain Maclear is giving special attention to this beautiful phenomenon. A *Mopsea*, which shone very brilliantly, gave a spectrum extending from the green well on into the red, while *Umbellularia* gave a very restricted spectrum sharply included between the lines *b* and D of this wonderfully rare sea-pea. We took with the trawl a very fine specimen, with a stem 3 ft. long, at a depth of 2,115 fathoms off Cape St. Vincent.

As usual in deep-sea work sponges preponderated, and the order has added several novelties, chiefly referable to the ventriculite group, the Hexactinellidæ.

Some fine new species of *Aphrocallistes* came u along the coast of Portugal, and off St. Vincent; wit many spicules and more or less mutilated examples of Hyalonema, two or three species in fair condition of a species of *Euplectella*, with spicules which I cannot distinguish from those of *Euplectella aspergillum*—the Venus flower-basket of the Philippines. The form of the two sponges is the same, but our own specimens are quite soft, the spicules not fused into a continuous siliceou network.

The physical and chemical observations will be fully detailed hereafter. The temperatures off the Coast of Portugal corresponded very closely with those taken in the *Porcupine* in 1870, and the *Shearwater* in 1871, below the first 100 fathoms through which at this season the temperature is nearly uniform.

WYVILLE THOMSON

PROF. FLOWER'S HUNTERIAN LECTURES

LECTURES X. XI. XII.

THE fossil *Dasypodidæ*, or their existing allies, are found in America only. They may be divided into two classes, those closely resembling existing species, and those differing considerably from them. Most of the former have only been obtained in a fragmentary state; they have been studied by Lund; one was peculiar in having the teeth compressed from before backwards, instead of laterally. The latter class includes a well-known form, *Glyptodon*, of which there are several species, and perhaps more than one genus. An exhaustive monograph is in course of publication by Burmeister on the genus, and the material he has at his command at Buenos Ayres is very large. In 1839 Prof. Owen was among the first to describe it, he did so from the specimen now in the Museum of the College, giving it the name by which we know it. The Danish naturalist, Dr. Lund, at about the same time gave the name *Hoplophorus* to the remains of a very similar animal, and Burmeister considers that there is sufficient difference between the two type specimens of these authors, that of the latter having one less hind toe, to justify the generic name proposed by each being retained. In *Glyptodon* the carapace is proportionately thicker and stronger than in existing Armadillos; it is composed of distinct pieces in contact at their edges, but not anchylosed, except in aged individuals; it is never hinged transversely, so the animal could not roll itself up. A horny epidermis undoubtedly covered the shield, and hairs may have been present, as foramina are frequently found. The scutes vary in shape in different species, and are of different sizes in different parts of the same individual. The tail formed a thick cylindrical scute-covered column, which in some cases was armed with spines and swollen near the tips, like a giant's club. An approach to this peculiar shape is seen in the existing *Chlamydophorus*. All known species have eight molars above, and the same number below on each side of each jaw, in a long straight, nearly parallel series, running very far back. The teeth all grew from persistent pulps, and were therefore long and slightly arched, with two deep flutings on each side, whence the name. In structure they were much as in the Armadillos, and the presence of the grooves caused the central harder osteodentine to assume a somewhat gridiron shape, which was sometimes much elaborated. The front of the skull was much truncated, and a strong ossified septum was often present. Burmeister thinks that the animal possessed a trunk. The brain was proportionately very small, the olfactory lobes and cerebellum preponderating. Much of the skull was occupied by air cells and the molar roots. The descending zygomatic process was very large, to give origin to the masseter muscle; it is absent or nearly so in the Armadillos; it may differ in character from that of the Megatherium, probably arising from the maxillaries, as it was perforated at its base by the infraorbital foramen. The vertebral column was most peculiar. Of the seven cervical vertebræ the first and sixth only were free, then came the "trivertebral bone" of Prof. Huxley, formed of the last cervical and first two dorsals; this was hinged ginglymoidly by the transverse processes on the next mass, which was composed of the rest of the dorsal vertebræ. The lumbar vertebræ were anchylosed together, but not to the last (the 13th) dorsal. The centra of the vertebræ were only represented by a thin bony plate which helped to form the tube for the spinal cord. Prof. Huxley thinks that the joint in the dorsal region was connected with the respiratory process, Burmeister considers that it enabled the animal to retract its head. The pelvis was much as in the Armadillo; the ilia were perpendicular. The symphysis pubis was slender, and is but infrequently preserved. The scapula possessed the characteristics of the class; the humerus had a supracondyloid foramen, and the radius and ulna were not anchylosed. The ungual phalanges were all hoof-like. As in the armadillos and seals, the 4th metarcarpal bone articulated with the cuneiform as well as with the unciform, and the 5th with the latter only; the pollex was absent. There was no third trochanter to the femur; the astragalus was normal; and there were four or five toes to the hind foot.

Of the other extinct Edentata there are none closely allied to the Ant-eaters, Ant-bears, or Pangolins. In the Upper Miocene of Darmstadt an ungual phalanx has been found, which like those of Manis is longitudinally split; it has been named *Macrotherium* by Lartet. Teeth have been found since, much like those of Dasypus, so it could not have been a Manis. At Pikerme similar remains have been found, which have been named as parts of *Ancylotherium*. These animals must form a separate division of the Edentata.

The *Ungulata* are the next great group to be considered. In their teeth they all tend to the typical formula $\text{i.}\ \frac{3}{3}\ \text{c.}\ \frac{1}{1}\ \text{p. m.}\ \frac{4}{4}\ \text{m.}\ \frac{3}{3} = 44$. The milk teeth are always functional and generally remain until the animal is nearly fully grown. The limbs are formed for simple support and progression, and there is no trace of clavicles. Except in the camels, the hoof encloses the ungual phalanx. Leaving Hyrax out of consideration it may be stated that the pollex and hallux are always absent. The class is found in all the world but the Australian region; they have not been found fossil in strata below the tertiaries, but in the oldest of them. They are absolutely divisible into two sub-classes from characters indicated by, but not entirely dependent on the structure of the feet. This division was indicated by Cuvier, but developed by Owen and H. N. Turner, Jun. Owen introduced the terms Perissodactylata and Artiodactylata by which these sub-classes are best known. In the *Perissodactylata* the middle toe is symmetrical, and there is typically one toe on each side of that, except in the Tapir and an early fossil Rhinoceros, *Acerotherium*. The astragalus has a single large anterior facet, entirely or mainly for articulation with the naviculare. There is a third trochanter to the femur, and there are never less than twenty dorso-lumbar vertebræ. The nasal bones expand posteriorly, and there is an osseous alisphenoid canal, as pointed out by Mr. Turner. In the *Artiodactylata* the axis of each of the feet is between the middle and fourth toe, and there is one toe outside each of these, but in the Peccary one is absent in the hind foot. The astragalus supports both the navicular and cuboid bones on nearly equal-sized facets. There is no third trochanter to the femur, and there are always nineteen dorso-lumbar vertebræ. There is no alisphenoid canal; the palate is completed by bone opposite the posterior molars. All these characters, especially when taken in connection with the teeth, make it easy, from a few fragments of the skeleton, to identify the sub-class to which fossil members of the class belong. In the Perissodactylata the persistent premolars and the molars are very much alike, being all double, but in the Artiodactylata the premolars are single, and therefore they do not form a uniform series with the molars; there is a third lobe to the last lower molar, except in an antelope, *Neotragus Saltiana*, as lately proved by Sir V. Brooke.

The earliest of the Perissodactylata are the *Lophiodontidæ*, from the lower Eocene. They are rather more generalised than the existing forms, as would be expected on the evolution hypothesis. The premolars are simpler than those behind. *Coryphodon*, the oldest, is known by its teeth, of which it possessed the typical forty-four, and a femur with a third trochanter. Its molars had two ridges with conical apices, whence Owen gave it its name, from a specimen dredged off Harwich. The feet are not known unfortunately.

Lophiodon itself is only known by its teeth and fragments of the skeleton; the upper part of the skull has not yet been found. It is a genus of the early and middle Eocene only. Its dental formula was $\text{i.}\ \frac{3}{3}\ \text{c.}\ \frac{1}{1}\ \text{p.m.}\ \frac{3}{3}\ \text{m.}\ \frac{3}{3}$. The molars are representatives of the type which runs through the whole class. In the upper jaw each tooth presented an outer wall, which developed into two well-formed cusps; running back from this were two transverse ridges, an anterior and a posterior, as they are termed. The anterior transverse ridge springs from in front of the anterior cusp, the posterior from in front of the one behind; these ridges, each by their curving backwards, enclose a space named the anterior and posterior sinuses. The posterior transverse ridge is absent in the premolars. The lower molars are simpler. The premolars were reduced in a manner which characterised the genus, the hinder part being cut away. Lophiodon is mainly found in the lacustrine deposits of the south of France; there were several species, varying in size from a full-grown Indian rhinoceros to that of a hare. Leidy, from the deposits of Nebraska, found a tooth exactly resembling those of this genus; he has named it *L. occidentalis*, but acknowledges the insufficiency of the evidence on which it is founded.

The next animals to be considered were about the size of the hare. *Pachynolophus* differed from Lophiodon in having seven pre-molars and molars in the upper jaw instead of six: the number in the lower jaw is not quite so certain, some having apparently six and others seven. The ridges of the teeth were less considerable and more broken into tubercles. In the London clay, near Herne Bay, a skull was found, named by Prof. Owen *Hyracotherium*. Mr. H. N. Turner was the first to point out that this animal was one of the Perissodactylata, and not as Prof. Owen at first supposed, allied to the Suidæ. The teeth very closely resembled those of Pachynolophus, each transverse ridge developing into a median smaller tubercle and a posterior larger one; the pre-molars were also considerably smaller than those behind. From the resemblance of the teeth it is evident that the French genus Pachynolophus and the English Hyracotherium must be considered to be one. *Pliolophus* is the name of a genus given by Owen to a specimen obtained from the London clay off Harwich, together with a humerus, femur, and three metatarsals. The forty-four teeth were present. There is no reason to suppose that this genus is different from Hyracotherium, the shape of the teeth and the size being identical; Prof. Owen himself states the possibility of their identity. The fact of there having been three metatarsals or metacarpals as they may be, found together, is a collateral one in favour of the animal having been Perissodactylate. From the above remarks it is evident that the names Pachynolophus and Pliolophus must be sunk in favour of Hyracotherium, as must also *Lophiotherium*, a name given by Gervais to an Upper Eocene specimen, known only by the mandible.

At the same time lived another small animal, *Miolophus*, known only from a fragment now at York. It differs from most ungulates in having only a single inner cusp to the molars, so causing it to resemble a typical pre-molar. Another form, *Microchœrus erinaceus*, is very aberrant, and its position is doubtful.

TESTIMONIAL TO DR. BENCE JONES

WE regret very much to hear that Dr. Bence Jones has been compelled on account of his health to resign the office of Secretary to the Royal Institution, a post which he has filled for so many years with equal honour to himself and advantage to the Institution.

His conviction of the value of original research, and of the special vocation of the Royal Institution to continue diligent in promoting it, was with him an unceasing stimulus to exertion. His attention to every detail left nothing neglected in the performance of his duties. His own scientific attainments have been of signal effect in maintaining respect for the Institution, and in procuring the co-operation of eminent men in the laboratories and lecture theatre. His love of the place and its memories has been shown by the pains he took to collect its early annals; including in this work an account of the discoveries of Young and Davy, and by his becoming the historian of Faraday.

The services of Dr. Bence Jones have been given under the pressure of important professional engagements, and latterly under the additional difficulties of failing health; and until now, when he has been reluctantly compelled to resign, he has never relaxed in the active prosecution of his honourable task.

We trust with the managers, however, that the aid of Dr. Bence Jones may not be altogether lost to the Institution; but that he will still afford to it the benefit of his counsels and experience. It is hoped that he may in future occupy a seat at the Board of Management; and further, that he will remain associated with the Institution by doing it the favour of accepting the position of Honorary Assistant-Secretary.

It has very naturally been proposed to present Dr. Bence Jones with a testimonial to be raised by subscription, and we feel confident that to so worthy a purpose there will be no lack of willing contributors. Individual subscriptions are limited to 3*l*. 3*s*. as a maximum.

It has been ascertained that the form of testimonial most agreeable to Dr. Bence Jones would be a bust of himself to be placed in the Royal Institution. Subscriptions to this testimonial may be paid either at the Royal Institution, or to "The Dr. Bence Jones Testimonial Account," at Messrs. Drummonds, the bankers, Charing Cross, who are authorised to receive the same.

CAPTAIN M. F. MAURY

MATTHEW FONTAINE MAURY, whose death, on Feb. 1, we recently recorded, was of French descent, and was born in Spottsylvania County, Virginia, Jan. 24, 1806. While still a child, his parents, who were in moderate circumstances, removed to Tennessee, where young Maury was sent to school. In 1825, when nineteen years old, he entered the service of the United States as midshipman, circumnavigating the globe in the *Vincennes*, during a cruise of four years. During this cruise Maury began his well-known "Treatise on Navigation," which was finished some years afterwards, and was for a long time used as a text-book in the U.S. navy. In 1836 he was made lieutenant and was gazetted astronomer to an exploring expedition.

In 1839, while travelling on professional duty, Lieut. Maury met with an accident which resulted in permanent lameness and unfitted him for active service afloat. What appeared then as a great misfortune to the lieutenant resulted indirectly in an increase of his fame, and in the performance of services of high value to science and humanity. The lame lieutenant was placed in charge of the Dépot of Charts and Instruments, out of which have grown the Naval Observatory and the Hydrographic Office of the United States. He laboured assiduously from the first day of his appointment to organise this dépot more efficiently than formerly. How completely he succeeded is well known.

While sailing around the globe in the *Vincennes*, Maury made many observations as to the winds and currents. These he continued in his subsequent cruises. When he became superintendent of the Hydrographic Office he determined to do something towards elucidating the intricate subject of ocean meteorology. The beginnings of this great undertaking were small. Maury obtained at first copies of such log-books as he or his friends could command. He noted the direction of the wind, the currents, &c., on the maps which he had prepared. As the information came in, districts were filled up and places pointed out for investigation. In 1842 the system had taken such consistency in his own mind that the lieutenant communicated to the U.S. Naval Bureau of Ordnance and Hydrography a plan for supplying model log-books to the commanders of vessels in the naval and merchant marine service. These log-books are so arranged that a systematic series of observations might be registered. The plan succeeded so well that in eight or nine years he had thus collected a sufficient number of logs to make 200 manuscript volumes averaging each about 2,500 days' observations each. These materials were digested by a board of officers appointed for that purpose, and the more immediate result of their labours was to show the necessity for combined action on the part of the maritime nations in regard to ocean meteorology.

In order that his labours might lead to some practical result, Maury wrought zealously to bring about a meeting of meteorologists belonging to all maritime nations; this led to the conference which met at Brussels in 1853, at which England, France, Russia, Portugal, Belgium, Holland, Denmark, Norway and Sweden were represented, and which produced the greatest benefit to navigation, as well as indirectly to meteorology. One of its most eminent and practical results was the establishment in London of the Meteorological Department of the Board of Trade. It recommended a model log-book for all vessels, in which a brief and uniform register of the principal meteorological phenomena are entered. The British Admiralty, the Royal Society, and the British Association entered heartily into Maury's plans, and aided him in every possible way; though we are ashamed to say that England is almost the only civilised country in the world that did not confer on this great benefactor of humanity some mark of honour: other countries loaded him with well-deserved tributes of admiration and gratitude for his services.

At the outbreak of the American civil war in 1861 Maury threw in his lot with the South, and did much to strengthen its maritime defences and enable it to hold out for so long as it did. He afterwards retired to England, where he lived for many years, and where he was presented with a handsome testimonial raised by subscription, he having lost nearly his all through his attachment to the unfortunate South. Having offered his services to the ill-fated Maximilian, of Mexico, the latter appointed him Imperial Commissioner of Emigration; and after the fall of that short-lived empire, Maury returned to the United States, taking up his residence in Virginia, where he lived until his death, on February 1 last. During his later years he devoted his time and efforts to urging his fellow-citizens of the south to leave politics alone and apply themselves energetically to the development of the agricultural resources of their country.

In 1856 appeared the first edition of Maury's "Physical Geography of the Sea," which ran through many editions in the United States, was republished in England, and translated into several European languages. In this work he embodied the results of his researches on winds and currents, and propounded his well-known theory of the Gulf-Stream. Although it has been shown that this theory will not hold water, it does not in the least detract from the high and enduring value of the services he rendered to navigation and to meteorology. There is no doubt that to him is due the honour of having first shown how the latter could be raised to the dignity and the certainty of a science, though, forsooth, it is yet far enough from deserving to be called an exact one. But Maury was essentially a practical man in the best sense of the term; all his labours from beginning to end had for their one great aim, to render navigation more secure and more economical; and in the accomplishment of this aim he was eminently successful. The saving in time, in money, and in life to Britain alone which has resulted from Maury's labours it would be very difficult to calculate; through him have the characteristics of almost every mile of that part of the ocean over which the commerce of the world is carried, become as well known as any district which has been mapped by the Ordnance Survey. Dr. Neumayer, than whom no one is better entitled to pronounce judgment on such a subject, in his recent pamphlet on the Exploration of the South Polar Regions, in opposition to some ill-informed detractors of Maury's fame, speaks of him in the very highest terms; and though we hesitate to class him, as a recent writer has done, with Newton, he will certainly, and deservedly, occupy a niche in the temple of fame as a benefactor of humanity and a promoter of scientific knowledge, to which not many men ever attain.

NOTES

THE Duke of Devonshire, Chancellor of the University of Cambridge, has consented to preside at the meeting of the friends of the late Prof. Sedgwick, which is to be held in the Senate House at Cambridge, on Tuesday, March 25, at two o'clock, to consider what steps shall be taken to raise a memorial to the late professor. Many men of eminence are expected to attend. It is rumoured that the memorial is likely to take the appropriate form of a new geological museum at Cambridge.

WE are sorry to record the death of the interesting wasp referred to by Sir John Lubbock in his address at last year's meeting of the British Association. It slept away as it were on Feb. 20 last, first the head dying, then the thorax, and then the abdomen. It has been deposited in the British Museum.

IN order that local inspectors of weights and measures may more conveniently and accurately compare all commercial measures containing subdivisions of the imperial yard, with verified copies of the official standard measures of length, which have been legalised under the provisions of the Standards Act, 1866, by Her Majesty's Order in Council of March 24, 1871, a model of a new subdivided standard yard, attached to a simple, ingenious, and comparatively inexpensive comparing apparatus, has been constructed by Messrs. Troughton and Simms, under the direction of the Warden of the Standards. This comparing apparatus has been expressly designed as one that may be used by local inspectors of weights and measures for comparing ordinary commercial measures of length, and it may now be inspected at the Standards Department.

WE have received a short paper by Mr. Lewis M. Rutherfurd on the stability of the collodion film. Urged by the statements of Mr. Paschen, in the "Astronomische Nachrichten" in April last, Mr. Rutherfurd determined to subject the question between dry and wet process to a thorough examination, and made a number of measures, proving conclusively the superiority of the former to the latter. This conclusion is of great importance in connection with the approaching Transit of Venus. In all cases save two the distance was greater between the lines when the plate was dry than when wet, the mean excess of the nine measures is Rev. 0·0017, which is $\frac{1}{58,230}$ of an inch; it reaches in no case $\frac{1}{4800}$ of an inch. This result is no doubt due to the cooling of the glass plate, by the evaporation which takes place the moment the wet plate is taken from the plate-holder and exposed to the air under the micrometer. This excess of distance (Rev. 0·0017), would be caused by an increase of temperature for the dry glass of about 4° F. This consideration reveals a source of error in the use of wet plates which he had not before considered, since the same evaporation takes place no doubt during the long exposures given to star plates; the amount will vary according to the hygrometric state of the atmosphere, and may be met by reading wet and dry bulb thermometers. Mr. Rutherfurd's objection to the method used by Mr. Paschen, is that instead of being confined to an investigation of what happens to the collodion film between the moment of exposure wet and the moment of measurement when dry, it is a comparison of the actual state of the plate when dry with what it ought to have been had all the adjustments, manipulations, and instruments been perfect.

AN exhibition for proficiency in natural science will be offered for competition at King's College, Cambridge, on April 22 and following days. Its value is 80*l*. a year for three years. It is open to all British subjects under 20 years of age who bring a satisfactory certificate of good character. The examination will be in chemistry, physics, and physiology, with elementary papers in classics and mathematics. Applications should be sent to the tutor before Easter-day, April 13.

WE mentioned some months ago that Vice-Chancellor Bacon had decided against the validity of the late Mr. Yates's bequest to University College of endowments for the chairs of Geology and Mineralogy, and of Archæology, on the ground that the testator had never fulfilled his expressed intention of framing a code of rules and regulations for the manner in which the appointments to the professorships should be filled up. We are glad to see that the Lord Chancellor has, on appeal, reversed the decision of the Vice-Chancellor, so that the College will derive the benefits from the will designed by the testator.

A COMMITTEE has been formed among the members of the Berlin Geographical Society, and a plan has been drawn up in conjunction with the other geographical societies of Germany, for the completion from the west coast of Africa of the discoveries commenced by Dr. Livingstone from the East. The Committee propose that the expedition should start from the West Coast south of the Equator. The funds for the proper equipment and maintenance of the expedition are already partly provided.

THE Edinburgh Botanical Society has decided to offer triennially a prize of ten guineas, as an encouragement for practical research. The subject for competition is to be announced by the council at the commencement of each triennial period, and the successful competitor must have been a student who has attended the botanical class at the Royal Botanic Garden, Edinburgh, during at least one of the preceding three years, and who has gained honours at the class examinations.

THE mode in which the Fertilisation of Grasses, and especially of Cereals, is effected—a question of no small importance from an agricultural point of view—has recently been the subject of a series of observations by Delpino in Italy, and Hildebrand in Germany; and the latter has published the result of his investigations in the "Monatsberichte" of the Berlin Academy. Both these acute observers are at issue with previous writers who maintained that the flowers of cereals, and especially of wheat, were self-fertilised in the unopened flowers, and consequently that the process could not be influenced by the wind. Hildebrand asserts, on the other hand, that impregnation takes place while the flower is open, and while the stigma is in a condition for the access of foreign pollen, that is, from other flowers. The opening of the flower of wheat, however, is completed in such a very short space of time that in a wheat-field there is probably never more than one in 400 of the flowers open at the same time. The contrivances by which in this case, as well as in other grasses, cross-fertilisation is at least rendered possible, are described in detail in the paper. In barley, on the other hand, the majority of the flowers never open, and self-fertilisation is the only condition possible. Delpino states, however, that there are in an ear of barley a very small number of flowers, differently constructed from the rest, in which cross-fertilisation is possible. In the oat the process is stated to vary according to the weather; in fine warm weather the flowers open freely, and cross-fertilisation is favoured; in cold wet weather they remain closed, and self-fertilisation is inevitable In rye, fertilisation from the pollen of other flowers is provided for. The agent in the dissemination of the pollen is scarcely ever insects, almost invariably the wind, to which end both stigma and pollen-grains are specially adapted.

WE regret to say that last week we were led to state that Mr. Cleminshaw, recently elected to the Burdett Coutts Scholarship, received his scientific training in the Applied Science department of that College. We are requested to say that this is incorrect, as Mr. Cleminshaw was only a few months at King's College, where he did not study geology at all, while he was for several years at Rugby, to which school really belongs the credit of having trained so successful a student: moreover, Mr. Cleminshaw is, we believe, the third Burdett Coutts' scholar from Rugby within a few years. It is a pity that any school should require to make haste to claim possession of an honour which is not justly its due.

A LIVING specimen of the extremely rare Liberian Hippopotamus (*Chœropsis liberiensis*), from Scarcies River, just north of Sierra Leone, arrived at Liverpool last week, but it unfortunately died on Friday, almost as soon as it reached its destination, Dublin. This second true hippopotamus was first described in 1844 by Dr. Morton, of Philadelphia, in the Journal of the Academy of Natural Sciences of that city. Prof. Leidy, in 1850, showed that its peculiarities rendered its differences from *Hippopotamus* more than specific, and in 1852 gave it the generic name by which it is now known. The full-sized animal is said to be no larger than a heifer, and the specimen under consideration, which was at least seven weeks old, weighed only 23 lbs., whereas the one born in London last November weighed just upon 100 lbs. shortly after birth. But the chief peculiarities of the genus *Chœropsis* are found in the teeth, as there are only two lower incisors instead of four, and the anterior premolars remain functional throughout the life of the animal, instead of being lost as is the case in *Hippopotamus*. In addition to these points in which *Chœropsis* is peculiar, it may be mentioned that the top of the head is convex instead of concave, the central upper incisors are slightly smaller than the outer, instead of larger, and the premaxillary bones are less developed than in Hippopotamus, from a young one of which, as M. A. Milne-Edwards remarks, it would be difficult to distinguish it externally.

FROM a memorandum affixed to the last part of Messrs. Sharpe and Dresser's "Birds of Europe," we learn that the latter gentleman has removed his entire collection of birds to No. 6, Tenterden Street, Hanover Square, where the work will in future be published, and which will henceforth be the head-quarters of the British Ornithologists' Union, as Messrs. Salvin and Godman have likewise removed their valuable collection of American birds to the same quarters, and Lord Lilford as well as Capt. Shelley have done the same with theirs.

A CHROME mine has been discovered at Chanli, in the province of Larissa, Turkey in Europe. It is said to be rich.

ON January 31, four shocks of earthquake were felt at Kara Hissar (query which) in Asia Minor. The shocks, of which the first two were rather violent, were repeated at intervals of twenty minutes. In the next afternoon, February 1, eleven more shocks were felt, which, though very sharp, only brought down three old abandoned houses. On Saturday, February 17, slight shocks of earthquake were felt in the island of Mitylene; the first at 1 A.M., and the second at 5.20 P.M. The oscillation was from west to east.—An earthquake that occurred on Dec. 29 last, at night, nearly destroyed the large town of San Vicente, in San Salvador, Central America. The upper half of the parish church fell, and many lives were lost.—At Bimlipatam, in India, a shock of earthquake was felt on January 25.—An earthquake is reported to have been felt at Peshawar, on Feb. 12. Its shock lasted for one minute.

ACCORDING to the *Times of India*, a phenomenon occurred in several parts of the province of Kattywar, on Feb. 12, which gladdened the eyes of the English residents, and excited astonishment in the natives. On that day the ground was whitened by a hailstorm, a phenomenon unprecedented in the experience of the natives, hundreds of whom are reported to have set about gathering the hailstones as they fell, in order to turn them into "the best of confectionaries."

THE collector of South Canara has brought to the notice of Government that the young shoots of the bamboo contain a bitter principle, which might be useful as a febrifuge.

THE Council of the Society of Arts will proceed to consider the award of the Albert medal early in May next. This medal was instituted to reward "distinguished merit in promoting arts, manufactures, or commerce," and was awarded last year to Mr. Henry Bessemer. The members of the Society are invited to forward to the Secretary, on or before April 12, the names of such men of high distinction as they may think worthy of this honour.

THE late Mr. George A. Clark, thread manufacturer, of Paisley, has left 20,000*l*. to Glasgow University for the establishment of four bursaries to be held by the successful competitors for four years, and to be so arranged that one bursary will be competed for each year. We hope the interests of science will not be forgotten in this matter.

THE additions to the Zoological Society's Gardens during the last week comprise a Condor Vulture (*Sarcorhamphus gryphus*) from S. America, presented by Lieut. L. C. Strachey, R.N.; a Lapland Bunting (*Centrophanes lapponica*), presented by Mr. F. Bond; a Mantell's Apteryx (*Apteryx mantelli*); an Amherst Pheasant (*Thaumelia amherstiæ*) from China, and a Tamandua Ant-eater (*Tamandua tetradactyla*) from S. America, deposited; two Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*) from Australia; two Red-eared Bulbuls (*Pycnonotus jocosus*) from India; two Cardinal Grosbeaks (*Cardinalis virginianus*) from N. America; a Long-tailed Glossy Starling (*Lamprotornis æneus*) from W. Africa; a Pantherine Toad (*Bufo pantherinus*) from Tunis; some Natterjack Toads (*Bufo calamita*) from Africa; a Bearded Lizard (*Amphibolurus barbatus*) from Australia; five Banded Sea Horses (*Hippocampus ramulosus*) from France, and some Anemonies, all purchased.

THE BIRTH OF CHEMISTRY

VIII.

General Character of Alchemy and the Alchemists.—The Pretiosa Margarita Novella.*—An Alchemistical Allegory.—Alchemical Symbols.—Paracelsus.—Libavius.*

WHAT manner of men were the Alchemists? How did they preserve, cultivate, and transmit the wonderful delusions of their creed? We have endeavoured in a former article to show that the idea of transmutation arose from the old Greek idea of the conversion of one element into another; and the belief in the possibility of transmutation once admitted, the pursuit of the alchemist would naturally follow in a mystical and credulous age. As to the men themselves, their character was twofold; for there was your alchemist proper, your true enthusiast, your ardent, persevering worker, who believed heart and soul that gold could be made, and that by long search or close study of the works of his predecessors, he could find the Philosopher's stone; and there was your knavish alchemist, a man who had wits enough to perceive that the search was futile, and impudence enough to dupe more credulous people than himself, and wheedle their fortunes out of them on pretence of returning it tenfold in the shape of a recipe for converting lead into gold. These last we may dismiss at once. They abounded during the Middle Ages, and found easy dupes, whom they deceived by the most shallow tricks, as by placing a piece of gold in the crucible of transmutation together with volatile substances, and after many processes and much heating, they would show the little button of metal which had all along been present.

Of the true alchemist we have many pictures. The alchemist, the astrologer, the mystic, the wizard, were men of the same stamp. They often practised the same arts side by side. The same habit and attitude of thought belonged to one and to all, and became all equally well. Take the dreamy, maudlin, semi-maniacal Althotas, who has been described so well by Dumas:—"An old man, with grey eyes, a hooked nose, and trembling but busy hands. He was half-buried in a great chair, and turned with his right hand the leaves of a parchment manuscript." Note also his intense abstraction, his forgetfulness of the hour, the day, the year, the age, the country; his absolute and intense selfishness, and absorption, the concentration of the whole powers of his soul upon his one object. Or let us look at Victor Hugo's Archidiacre de St. Josas, in his search for the unseen, the unknown, and the altogether uncanny; the bitterness of his soul, his passionate musings, his conjurations and invocations in an unknown tongue; his own self, that wonderful mixture of theologian, scholar, mystic, perhaps not much unlike the divine S. Thomas Aquinas himself. Listen to his musings: "Yes, so Manon said, and Zoroaster taught:—the sun is born of fire, the moon of the sun; fire is the soul of the universe; its elementary particles are diffused and in constant flow throughout the world, by an infinite number of channels. At the points where these currents cross each other in the heavens they produce light, at their points of intersection they produce gold. Light!—gold! the same thing; fire in its concrete state. . . . . What! this light that bathes my hand is gold? The first the particles dilated according to a certain law, the second the same particles condensed according to another law! . . . For some time, said he, with a bitter smile, I have failed in all my experiments; one idea possesses me, and scorches my brain like a seal of fire. I have not so much as been able to discover the secret of Cassiodorus, whose lamp burned without wick or oil—a thing simple enough in itself." If we peep into Dom Claude's cell, we are introduced to a typical alchemist's laboratory—a gloomy, dimly-lighted place, full of strange vessels, and furnaces, and melting pots, spheres, and portions of skeletons hanging from the ceiling; the floor littered with stone bottles, pans, charcoal, aludels, and alembics, great parchment books covered with hieroglyphics; the bellows with its motto *Spira, Spera;* the hour-glass, the astrolabe, and over all cobwebs, and dust, and ashes. The walls covered with various aphorisms of the brotherhood; legends and memorials in many tongues; passages from the Smaragdine Table of Hermes Trismegistus; and looming out from all in great capitals, ΑΝΑΓΚΗ. Yet once again, look at Faust, as depicted by Rembrandt, or Teniers, unknown alchemist, if you wish for an alchemical interior.

But the hard-working and enthusiastic alchemist did not always follow the ideal of the novelist and artist; he often degenerated into a "dirty, soaking fellow," who lost what little learning he ever had by concentrating his mind on the one dominant topic, until it excluded every other idea and aspiration; then the pursuit became all absorbing, and the disciple of the art a mere drivelling monomaniac.

We will now look at one of the books which were cherished by the alchemists. Here is a little vellum-covered *Aldus*: date 1546. Paracelsus had been dead five years, and Cornelius Agrippa, twelve years; Dr. Dee and Oswald Crollius were flourishing; Van Helmont and a host of known alchemists were unborn. Our little volume, full of quaint musings of a bygone age, has outlived them all, and yet it never drank of the *elixir vitæ*, although it pretended to teach others how to make it, and the philosopher's stone into the bargain. *Pretiosa Margarita Novella de Thesauro, ac pretiosissima Philosophorum Lapide* is the title; published with the sanction of Paul III. Pontifex Maximus, whose successor, be it remembered, established the *Index Expurgatorius*, and might possibly have prohibited the Precious Pearl of alchemy. The title-page goes on to tell us that it contains the methods of the "divine art," as given by Arnaldus de Villâ Novâ, Raymond Lulli, Albertus Magnus, Michael Scotus, and others, now first collected together by Janus Lacinius. The vellum cover is well thumbed, and in one place worn through, perhaps by contact with a hot iron on an alchemist's furnace-table, or by much use. There are no MS. notes, but on the title-page is the autograph of Sir C. Koby, or Hoby, and a favourite maxim, the first word of which alone—*Fato*—is legible. The date of the writing is perhaps 1580-90. Some initial letters of the text have been plainly illuminated in red, by a loving hand; they were copied from a bible printed at Lyons in 1326.

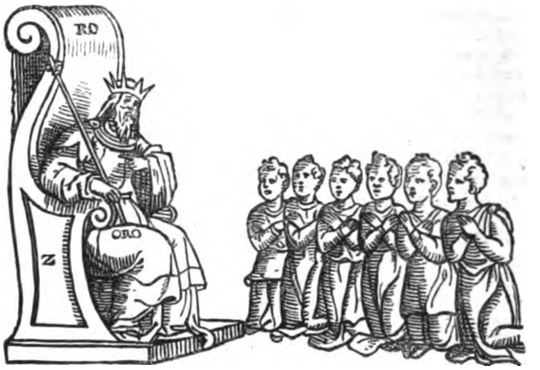


FIG. 14.—Allegorical representation of transmutation.

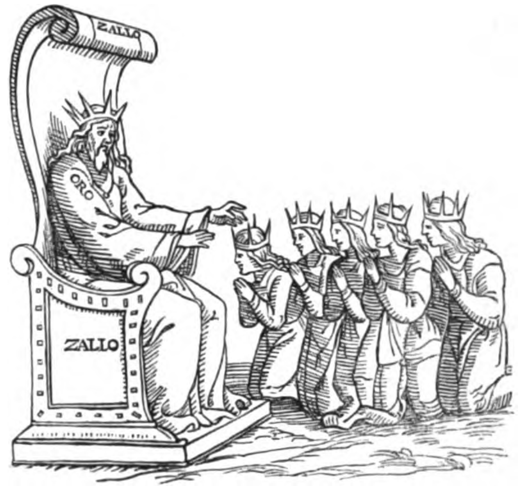


FIG. 15.—Allegorical representation of transmutation.

As to the contents we have firstly an opening address by Janus Lacinius, then certain definitions of form, matter, element, colour, &c. Next, symbolic representations of the generation of the metals, and after this a woodcut representing the transmutation of the elements according to the dogmas of Aristotle.* After this we find the whole course of transmutation set forth pictorially and allegorically, as under. A king (see Fig. 14) crowned with a diadem, sits on high, holding a sceptre in his hand. His son, together with his five servants, beseech him on bended knees, to divide his kingdom between them. To this the king answers nothing. Whereupon the son at the instigation of the servants, kills the king and collects his blood. He then digs a pit into which he places the dead body, but at the same time falls in himself, and is prevented from getting out by some external agency. Then the bodies of both father and son putrefy in the pit. Afterwards their bones are removed, and divided into nine parts, and an angel is sent to collect them. The servants now pray that the king may be restored to them, and an angel vivifies the bones. Then the king rises from his tomb, having become all spirit, altogether heavenly and powerful to make his servants kings. Finally he gives them each a golden crown, and makes them kings (Fig. 15).

It is difficult to follow this from beginning to end, but there can be no doubt that the king signifies gold, his son, mercury, and his five servants the five remaining metals then known, viz. iron, copper, lead, tin, and silver. They pray to have the kingdom divided amongst them, that is to be converted into gold; the son kills the father, viz. the mercury forms an amalgam with gold. The other operations allude to various solutions, ignitions, and other chemical processes. The pit is a furnace; putrefaction means reaction or mutual alteration of parts. At last the philosopher's stone is found, the gold, after these varied changes becomes able to transmute the other metals into its own substance. At the end some rugged hexameters and pentameters warn the fraudulent, the avaricious, and the sacrilegious man that he is not to put his hands to the work, but to leave it for the wise and the righteous, and the man who is able rightly to know the causes of things.

After this allegory we have some remarks concerning the treasure and the Philosopher's Stone, and the secret of all secrets, and the gift of God. This is followed by a number of arguments against alchemy, and of course overwhelming arguments in favour of it. Among those who are quoted as alchemists are Plato, Pythagoras, Anaxagoras, Democritus, Aristotle, Morienus, Empedocles, and then, with a delightful disregard of age or country, we read, "Abohaby, Abinceni, Homerus, Ptolemæus, Virgilius, Ovidius." Then digressions on the difficulties of the art, the unity of the art, the art natural and divine; a slight history of the art, in which it is traced back to Adam, although Enoch and Hermes Trismegistus are mentioned as possible founders. A treatise to prove that this art is more certain than other sciences; on the errors of operation; on the principles of the metals; on sulphur; on the nature of gold and silver; and many general remarks on all alchemical subjects. These are the teachings which the *Pretiosa Margarita Novella* pours at the feet of the wise among mankind, by the aid of Paulus Manutius, bearing his father's name of Aldus, and by the grace of the Venetian Senate.

Many attempts were made by the alchemists to explain the origin of the metals; some regarded them as natural compounds of sulphur and mercury, others affirmed that the action of the sun acting upon and within the earth produced them, and that gold was in truth condensed sunbeams; many believed that metals grew like vegetables, indeed it was customary to close mines from time to time to allow them to grow again. Basil Valentine, as we have seen, regarded them as condensations of a "mere vapour into a certain water," by which latter we suspect he meant mercury. Perhaps the most absurd account of the origin of certain things is given by Paracelsus in his treatise, "De Natura Rerum," in the following words, which will show also how utterly nonsensical and unintelligible alchemical language could be, and for that matter very generally was. "The life of metals," he writes, "is a secret fatness; . . . of salts, the spirit of aquafortis; . . . of pearls, their splendour; . . . of marcasites and antimony, a tinging metalline spirit; . . . of arsenics, a mineral and coagulated poison . . . The life of all men is nothing else but an astral balsam, a balsamic impression, and a celestial invisible fire, an included air and a tinging spirit of salt. I cannot name it more plainly, although it is set out by many names."

The peculiarly secret and mystical language which the alchemists adopted was intended to prevent the vulgar from acquiring the results of their long-continued labours. Their language purported to be intelligible to the true adept; but as a rule the alchemists of one age gave various interpretations to one and the same secret communicated by their predecessors. Long recipes for the preparation of the Philosopher's Stone exist, which the authors have generously (as they tell us) given to the world, after much labour, for the benefit of their fellow men. The obscurity of the science was increased by the multiplication of symbols; the presence of which in alchemy clearly points to its connection with astrology and the sister sciences. In time alchemical symbols multiplied almost as much as astrological symbols. In an Italian MS. of the early part of the seventeenth century which we have before us, mercury is represented by 22 distinct symbols, and 33 names, many of which are of distinctly Arabic origin:—such as Chaibach, Azach, Jhumech, Caiban. Lead is represented by the symbols in Fig. 16, and in addition to its ordinary alchemical names, is called Okamar, Syrades, Malochim, and others. The designation of substances as "the green lion," "the flying eagle," "the serpent," "the black crow," and so on, also led to considerable confusion. Both names and symbols were used in a somewhat arbitrary fashion.

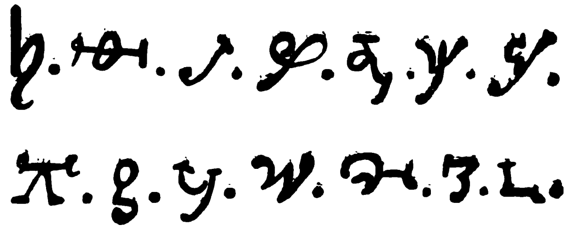


FIG. 16.—Symbols of Lead from Italian MS. of the seventeenth cent

It is somewhat strange to think that alchemy should have once received the serious attention of the legislature in this country. In 1404 the making of gold and silver was forbidden by Act of Parliament. It was imagined that an alchemist might succeed in his pursuit, and would then become too powerful for the State. Fifty years later Henry VI. granted several patents to people who thought they had discovered the philosopher's stone; and ultimately a commission of ten learned men was appointed by the King to determine if the transmutation of metals into gold were a possibility. We must now leave the subject of alchemy. Those who desire to study it more deeply will find a great mass of matter in the *Bibliotheca Chemica Curiosa* of Mangetus;

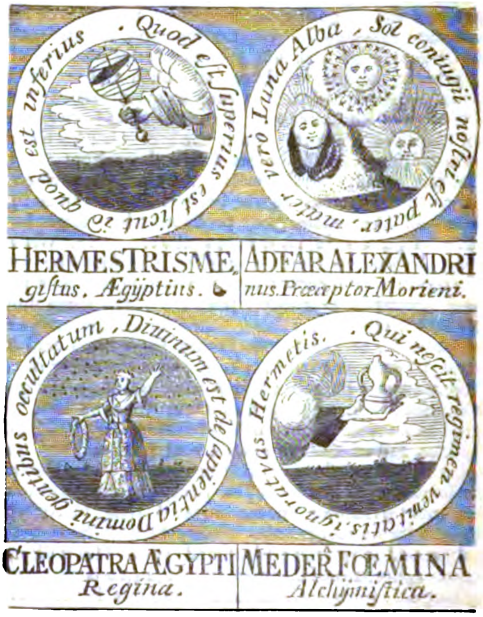

Quod est superius est sicut quod est inferius
Sol conjugi nostri est pater, mater verò Luna Alba
HERMES TRISMEgistus, Ægyptius.
ADFAR ALEXANDRInus. Præceptor Morieni.
Divinum est de sapientia Domini gentibus occultatum
Qui nescit regimen ventris ignorat vas Hermetis.
CLEOPATRA ÆGYPTI Regina.
MEDERA FŒMINA Alchymistica.

FIG. 17.—Designs from Mangetus (*Bibliotheca Chemica Curiosa*)

but if they will take our advice, they will not waste much time in studying the history and progress of a futile and false art.

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* See the first of these Articles.

With Paracelsus (b. 1493, d. 1541), a somewhat new phase of the science of chemistry appeared. By pointing out the value of chemistry as an adjunct to medicine, he caused a number of persons to turn their attention to the subject, and to endeavour to ascertain the properties of various compounds. Thus he helped to withdraw men from the pursuit of alchemy, by asserting that the knowledge of the composition of bodies, which had necessarily been forwarded by alchemy, was of importance to the human race, for the better prevention and curing of their ills. In the way of discovery or research, Paracelsus did little. He mentions zinc and bismuth, and associates them with metallic bodies, and he makes considerable use of several compounds of mercury, and of sal ammoniac. Paracelsus compares the alchemist of his day with the physician, and speaks of the former in the following terms:—"For they are not given to idleness, nor go in a proud habit, or plush and velvet garments, often showing their rings upon their fingers, or wearing swords with silver hilts by their sides, or fine and gay gloves upon their hands, but diligently follow their labours, sweating whole days and nights by their furnaces. They do not spend their time abroad for recreation, but take delight in their laboratory. They wear leather garments with a pouch, and an apron wherewith they wipe their hands. They put their fingers amongst coals, into clay, and filth, not into gold rings. They are sooty and black like smiths and colliers, and do not pride themselves upon clean and beautiful faces."

Among the Paracelsians we find Oswald Crollius, who mentions chloride of silver under the long-retained name of *luna cornea*, or horn-silver, from its peculiar horny appearance and texture after fusion. He was also acquainted with fulminating gold.

The name of Andrew Libavius (died 1616) deserves mention, because he sought to free chemistry from the mazes of alchemy and mysticism in which it was involved. In this he to some extent succeeded; and he appears also to have been a patient worker in the field of the science which he did so much to promote. He discovered the perchloride of tin which is even now called *fuming liquor of Libavius*; he also proved that the acid (sulphuric acid) procured by distilling alum and sulphate of iron, is the same as that prepared by burning sulphur with saltpetre. Libavius was great at the making of artificial gems, and was able to imitate almost any precious stone by colouring glass with various metallic oxides.

G. F. RODWELL

SCIENTIFIC SERIALS

THE *Zoologist* continues Dr. J. E. Gray's catalogue of the whales and dolphins inhabiting or incidentally visiting the seas surrounding the British Isles.—The Rev. A. C. Smith gives the results of the observations of Dr. Rey, of Halle, on the colouring of cuckoos' eggs, which are in favour of Dr. Baldamus theory.—From notes by Mr. J. Sclater and Mr. J. Gatcombe, from Castle Eden and Plymouth, we find that the glaucous gull has been obtained in both places, and the winds have driven ashore several other sea-birds, petrels, &c.

THE *Monthly Microscopical Journal* commences with the excellent address of the president of the Microscopical Society, the perusal of which, from the enthusiasm exhibited, will convince sceptics that there is a fund of enjoyment in science equal to that in other mental occupations.—Mr. Parker also contributes a paper on the development of the skull in the thrushes.—The Rev. S. L. Brackey has a paper on reduced apertures in immersion objectives, a subject on which Mr. R. B. Tolles and Mr. F. H. Wenham have a correspondence.—There is a short and severe review of Dr. Bastian's "Beginnings of Life."—Mr. S. Wells has a paper on the structure of *Eupodiscus Argus*, and G. W. Royston-Pigott one on spurious appearances in microscopic research.—Captain T. H. Lang gives a short abstract of Prof. Smith's "Conspectus of the Diatomaceæ," which has appeared in the *Lens*.

PETERMANN'S *Mittheilungen* (19 Band, 1873, ii). The first paper is another contribution to the literature of North Polar Exploration by J. Spörer, in which he shows the importance to science and humanity of records of exploration. One of the maps in this number shows the route followed by two Russians, Pawlinow and Matusowski, in their politico-commercial expedition of 1870, in Western Mongolia. Herr Fricke, a German merchant who has extensive connections both in East and West Africa, writes, giving several interesting details concerning the state of trade with the interior of South Africa, both from the east and west coast, showing that European connections with the interior extend much further than is indicated in our geographies and maps.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 13.—"Note on Supersaturated Saline Solutions." By Charles Tomlinson, F.R.S.

"Visible Direction: being an Elementary Contribution to the Study of Monocular and Binocular Vision." By James Jago, M.D. Oxon., A.B. Cantab., F.R.S.

Anthropological Society, March 11.—At this, the first meeting of this Society, the rules proposed by the Organising Committee were adopted, subject to confirmation at the first Annual General Meeting; and the following officers were elected:—President—Dr. R. S. Charnock, F.S.A. Vice-Presidents—Capt. R. F. Burton, F.R.G.S., and C. Staniland Wake. Treasurer—Joseph Kaines. Council—Dr. J. Beddoe, H. B. Churchill, Dr. Barnard Davis, F.R.S., John Fraser, Dr. G. Harcourt, Dr. Sinclair Holden, Dr. T. Inman, Dr. Kelburne King, Dr. J. Barr Mitchell, and T. Walton. Hon. Sec.—A. L. Lewis. Hon. For. Sec.—Dr. Carter Blake. This Society has been founded in consequence of a difference of opinion among the members of the Anthropological Institute, and a letter from Capt. Burton, the well-known traveller, heartily supporting the new organisation, was read.

Geologists' Association, March 7.—Henry Woodward, F.G.S., &c., president, in the chair.—"On the Geology of Brighton," by Mr. James Howell. Surface indications did not, he believed, afford evidence that the northern portion of the Downs had been submerged since its upheaval. Historical documents, submerged forests, and the shallowness of the sea's bottom, afforded abundant proof of the great encroachment of the sea along this part of the coast of Sussex during the historic period. The site of Old Brighton was stated to be seaward between East and West Streets, and not, as Lyell states, where the chain-pier now stands; and the coast line at the period when the Brighton Valley was an estuary of the sea and a river, was very different from what it is now. The geological formations at Brighton were stated to be six, viz. silt in the valley, brick-earth of Hove, the Elephant-bed, Temple-field deposit, plastic clay of Furze Hill, and the upper chalk. The present paper embraced Mr. Howell's observations of the first three. In the lower portion of the silt and the coombe rock beneath it, are embedded immense numbers of water-rolled sandstones, similar to the sarsenstones distributed over the surface of the downs; but whether of Wealden or Tertiary origin is unknown. The brick-earth is a later formation than the elephant-bed upon which it everywhere rests, though the fossiliferous remains embedded in it are the same, viz., those of the mammoth, horse, red-deer, whale, and shells of an Arctic type. If, as Mr. Godwin Austen tells us, brick-earth is the wash of a terrestrial surface, how are we to account for the marine remains embedded in it? The pebbles of Palæozoic rocks, found in the old sea-beach under the elephant-bed, were stated to have come from France, when that country was united to Britain, having travelled along a beach once extending from Brighton to Calvados. The observations of Mr. Howell, of how pebbles and pieces of rock travel along a coast, aided by sea-weed to which they may be attached, supported this opinion. The author in conclusion opposed the opinion entertained by the geological section of the British Association during their visit to the Kemp Town section of the elephant-bed, that this remarkable deposit was formed by ice-action, and adduced the fact that the materials composing it are all water-rolled as corroborating the opinions of Webster, Mantell, and Lyell.

DUBLIN

Royal Geological Society, Jan. 8.—Professor Macalister, president, in the chair.—The Rev. Dr. Haughton, F.R.S., read a paper on Stirm's Fertiliser, from New Hampden, U.S.—Rev. Maxwell Close read some Notes on the High Level Gravels near Dublin.

Feb. 12.—This was the annual meeting. The outgoing president, Professor Macalister, delivered the annual address, selecting for the theme of his discourse, the subject of Micro-petrography—a subject in which a vast amount of work remains to be done—one, it is feared, not so much known as it deserves to be, and much misunderstood. Workers are needed to follow up the lines of research of Rosenbusch, Lasault, and Fuchs, who are working out the correlation of petrography and petrology, the structure in regard to the position of the rock mass. As an an appendix to his address, Prof. Macalister gives an important bibliography of the subject of Microgeology. Prof. E. Hull, F.R.S., was elected President for the ensuing session.

PARIS

Academy of Sciences, March 10.—M. de Quatrefages, president, 'in the chair.—M. Berthelot took his seat as a member of the Academy. The following papers were read:—On Father Secchi's new hypothesis by M. Faye. The author replied to the Rev. Father's late note by proving that he had first stated that the solar spots were craters of eruption, and next that they were not eruptions, but were caused by them being in fact the erupted matter cooled by its passage above the chromosphere, the faculæ being the centres of eruption.—M. Faye showed this to be incompatible with the observed facts, the spots being surrounded with faculæ, whereas, according to Secchi's last theory, they ought to surround faculæ.—On the circulation of solar hydrogen, with an answer to some remarks by M. Tacchini, by M. Faye, treated of the spot phenomena; the author thinks that hydrogen is drawn down by the cyclones and returns to the surface around them. He also suggested that D_3 would probably be found to belong to a very rarified hydrocarbon of the acetylene series.—On the density of the vapour of phosphoric chloride, by M. Wurtz, who found that when precautions were taken, to prevent dissociation, the normal two volumes was occupied, experiment giving 7·226, and theory requiring 7·217.—On the springs of the Seine basin by M. Belgrand.—Researches on the action of the tympanic chord on the circulation in the tongue, by M. A. Vulpian.—On the industrial production of cold by the detention of permanent gases and of air in particular, by M. Armengaud.—On the production of silent electric discharges and on their mode of action, by M. Boillot.—Experiments on putrefaction, &c., by M. Laujorrois.—On the assimilability of phosphates, by M. H. Joulie.—A note on the unity of force and of matter, by Madame C. Royer.—On the theory of solar spots, by M. Tacchini, was an answer to M. Faye. The author contends that the hydrogen carried down by the cyclones ought to return up their axes, and not around them; and as this is not the case, he thinks that his criticisms remain unrebutted.—A paper on the trajectories of points, &c., by M. Mannheim.—On benzylated naphthalin, by M. Ch. Frotté. The body in question is produced by the action of benzylic chloride on naphthalin in the presence of powdered zinc.—On a combination of urea with acetylic chloride, by M. D. Tommasi. An atom of hydrogen in urea is replaced by the acetyl compound.—On the composition of guanos, &c., by M. A. Baudrimont.—On asphyxia and on the causes of the respiratory movements in fishes, by MM. Gréhant and Picard.—On the influence of ammonia in manufactories where mercury is employed, by M. J. Meyer. The author asserts that he has succeeded in stopping all the terrible effects of mercurial poisoning in the silvering rooms of the Saint Gobain glass works by watering the floors every evening with half a litre of commercial ammonia. He states that since 1868 he has not had a single workman attacked.—On the saccharine matter of mushrooms, by M. A. Müntz.—On the normal microzymes of milk as the cause of the coagulation and alcoholic, acetic, and lactic fermentations of that liquid, by M. A. Béchamp.—On the quaternary fossils collected by M. Œlert at Louverné (Mayenne), by M. A. Gaudry.—On the existence of man in Alsace during the glacial epoch, by M. Ch. Grad.—On the movements of the atmosphere as regards the prediction of weather, by M. de Tastes.—On the use of vermouth, by M. E. Decaisne. The author thinks that the use of this liquid as a drink ought to be abandoned.

DIARY

THURSDAY, March 20.

ROYAL SOCIETY, at 8.30.—On the Distribution of Vertebrata in Relation to the Theory of Evolution: Dr. J. D. Macdonald.—On the Temperature at which Bacteria, Vibriones, and their supposed Germs are killed when immersed in Fluids or Exposed to Heat in a Moist State: Dr. Bastian.—Some New Theorems on the Motion of a Body about a Fixed Point: E. J. Routh.

SOCIETY OF ANTIQUARIES, at 8.30.—On the Hunnebedden of Drenthe in the Netherlands; Miscellaneous Antiquities: Governor Gregory.

ZOOLOGICAL SOCIETY, at 4.

LINNEAN SOCIETY, at 8.—On the "Take-all" Corn Disease of Australia: Dr. Mücke.

CHEMICAL SOCIETY, at 8.—On Iron and Steel: C. W. Siemens.

ROYAL INSTITUTION, at 3.—The Chemistry of Coal and its Products: A. V. Harcourt.

FRIDAY, March 21.

ROYAL INSTITUTION, at 9.—On the Mythology of India: E. D. Lyon.

OLD CHANGE MICROSCOPICAL SOCIETY, at 6.30.—Annual Meeting.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

QUEKETT CLUB, at 8.—Conversazione.

SATURDAY, March 22.

ROYAL INSTITUTION, at 3.—Darwin's Philosophy of Language: Max Müller.

SUNDAY, March 23.

SUNDAY LECTURE SOCIETY, at 4.—The Theory of Stringed Musical Instruments: W. H. Stone.

MONDAY, March 24.

GEOGRAPHICAL SOCIETY, at 8.30.—Notes on Khiva, and Routes leading to that country: Major-Gen Sir H. C. Rawlinson, K.C.B., President.

LONDON INSTITUTION, at 4.—Fungoid Organisms: Prof. Thiselton Dyer.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

TUESDAY, March 25.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

WEDNESDAY, March 26.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

LONDON INSTITUTION, at 7.—Courts of Special Commercial Jurisdiction. N. H. Paterson.

SOCIETY OF ARTS, at 8.—On the Edible Starches of Commerce: P. L. Simmonds.

GEOLOGICAL SOCIETY, at 8.—Synopsis of the Younger Formations of New Zealand: Capt. F. W. Hutton.—On the Tree-ferns of the Coal-measures and their Relations to other living and fossil forms: W. Carruthers.—Notes on the Geology of Kazirùn, Persia: A. H. Schindler.

ARCHÆOLOGICAL ASSOCIATION, at 8.

ROYAL SOCIETY OF LITERATURE, at 8.30.—The Rhodian Law, and its connection with the Laws of Mediæval Europe: W. S. W. Vaux.

SOCIETY OF TELEGRAPH ENGINEERS, at 7.30.—On a new method of testing short lengths of highly Insulated Wire: Prof. Fleeming Jenkin.—On some points in connection with the India Government Telegraphs: W. E. Ayrton.

THURSDAY, March 27.

ROYAL INSTITUTION, at 3.—Coal and its Products: A. V. Harcourt.

ROYAL SOCIETY, at 8.30.

SOCIETY OF ANTIQUARIES, at 8.30

BOOKS RECEIVED

ENGLISH.—A Manual of Metallurgy: G. H. Makins (Ellis & White).—The Atmosphere, Ed. by J. Glaisher (Sampson & Low).—The University Oars: Dr. J. E. Morgan (Macmillan).—Chaureau's Comparative Anatomy of the Domesticated Animals. 2nd edit. Translated by G. Fleming (Churchill). The Scientific Bases of Faith: J. J. Murphy (Macmillan).—Mensuration: D. Munn (Chambers).—Essay on the Physiology of the Eye: S. H. Salom (S. H. Salom).—The Year Book of Facts, 1873: J. Timbs (Lockwood).—Steam in the Engine; its Heat and its Work: P. Kauffer (Blackie).—Results of Meteorological Observations made in the Royal Observatory, Cape of Good Hope: Sir Thos. Maclear (Solomon).—Chemistry for Schools; an Introduction to the Practical Study of Chemistry. 2nd edit: C. H. Gill (Stanford).—Handbook for the Physiological Laboratory; Brunton-Foster, Klien, and Sanderson.

AMERICAN.—One Law in Nature: Capt. H. M. Lazelle (D. V. Nostrand, New York).

PAMPHLETS RECEIVED

AMERICAN.—United States Commission of Fish and Fisheries, Pt. 1. Report on.—Condition of the Sea Fisheries of the South Coast of New England in 1871–2: S. F. Baird.—On the Glacial and Champlain Eras in New England: J. Dann.—Proceedings of the Academy of Natural Sciences, Philadelphia.

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THURSDAY, MARCH 27, 1873

UNIVERSITY OARS

I.

WE have, not without motive, adopted the title of Dr. Morgan's book,*—so opportunely timed in its issue by its University publishers—as the heading for some considerations connected with the coming river "Derby;" for we propose to pass in review the leading features of the Hygienic value of these contests, which are claiming and receiving from year to year a growing importance, into which the book itself is an exhaustive inquiry.

Many a strong hand will tremble as it lifts this book for the first time, and many an eye will glisten with pleasure or grow dim with regret as it scans its lists and tables and reads the revelations made therein. For what do they tell—and tell too with a rare fulness and circumstantiality? All particulars as to the health, past and present, of the Oarsmen of both Universities who have rowed in the annual matches during the last forty years; that is, from the time of their organisation up to the last race rowed before the author began collecting the materials for his book. Year by year the crews are formed and the races rowed. Year by year the races pass and are forgotten, and the crews disappear and are *not* forgotten, although they may pass away from our sight. What has become of the old Oarsmen, the friends and favourites of other days? Are they "doing duty" in peaceful country parishes, or in crowded cities at home? or have they venturously gone forth to new lands to seek for more genial employments than the old one yields? What are they doing now? how fares it with them? and above all, have they suffered in heart or brain, in nerve or lung, from their old practice at the oar? The ample lists in Dr. Morgan's book, his own ably written pages, and the liberal extracts from his correspondents' answers to his queries — his correspondents being the oarsmen themselves and his queries being with sole reference to their health and bodily condition—tell us all: tell us where they are, what they are doing, what they did when with us and how they did it; and, in their own language, tell with characteristic frankness, and in words which we can still recognise as their old modes of expression, what they think and believe for or against their old favourite pastime. All write cheerily, and all to a man almost speak with prideful remembrance of their work at the oar, and the good they have derived from it. From Bengal writes McQueen:—"I am now a stout man, weighing fifteen stone, but able to be in the saddle all day without fatigue, or if necessary walk my ten or fifteen miles without any distress." We wonder if he still possess the same hand-power that he had in his youth? He had simply the strongest hand and wrist we have ever known, and never did we place our own palm in his without setting our teeth close, and subjecting the member when set free to a gentle manipulation, to restore circulation and revive feeling in its flattened digits. His was the true Herculean build. Nind writes from Queensland on "Since taking my degree in 1855 my constitution has been put to the test in many climates, for I have lived in Canada, on the west coast of America, and in Australia, and I can safely aver that I never have in trying circumstances found a failure of physical power; and that when hard pressed by fatigue and want of food, the recollection of the endurance developed by rowing and other athletics gave me fresh spirit and encouragement." And yet Nind was not naturally a powerful man. His frame was the very antithesis to that of McQueen. Those who remember him as he first came to the University will recall his exquisitely moulded features, almost feminine in their softness and sweetness of expression. Schneider writes from New Zealand:—"I may state that so far as I am concerned, I am able to discover no particular symptoms either good, bad, or indifferent specially attributable to rowing. . . . . I now come to what I believe to be the chief if not the only real danger attendant upon Boat-Racing, and that is the violent strain upon the action of the heart caused by rowing a rapid stroke and exerting every energy to maintain the same to the end of the race."

Who among us could argue the matter more wisely? These are bright and pleasant pictures, but like all other pictures, they have their dark side. In the lists of Oarsmen certain names are printed in italics—not many, thank God!—a small percentage only. These are they who have rowed out their life-race; who have for ever passed out from their period of training and of trial. They rise before our mind's eye as we first knew them. Brewster's magnificent form towering half a head above his stalwart shipmates. Men are all wise after the events; and we hear now of those who always doubted his real strength and stamina, and point to his untimely end as evidence of their own penetration. "Invalided from his regiment, caught cold by returning wet from a Brighton Volunteer Review: died from its effects." Polehampton, the chivalrous, the gentle, the brave! "Decorated while at college with the Royal Humane Society's Medal for saving a companion from drowning at his own imminent peril. Shot through the body at Lucknow — and died of cholera when attending to his comrades stricken by the same malady." The very career he would have marked out for himself, had it been left to his hand to trace it! Hughes, the accomplished, the frank, the manly—the very nature that, speaking in our love and in our pride, we emphatically style the beau-ideal of an English gentleman—"died last year of inflammation of the lungs." Here our personal reminiscences of old oarsmen must cease.

For many a long year strange tales of the risks and dangers of rowing, or rather of boat-racing, have had a floating existence in the Universities, and gaining strength and circumstantiality by time and repetition, have extended to wider circles. While the old tales lived and held their own, other and more startling legends sprang up, and also grew into importance, legends so alarming, and related with such circumstantial detail, that the most sceptical began to think that "there must be something in it." Whole crews, it was stated, had been swept off in a few brief years by their terrible struggles and efforts at the oar. This feeling of uneasiness, if not of absolute alarm, attained a sort of climax a few years ago by the letters of an eminent surgeon, published in the *Times.*

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* "University Oars." By John Ed. Morgan, M A. Oxon, F.R.C.P. (Macmillan, 1873)

For reasons which seemed to his professional judgment sufficient, he took the side of the alarmists, and pronounced an opinion, strongly expressed, against boat-racing as now practised. These letters were answered with more or less ability by votaries of the oar, men then actively engaged in rowing, or who had recently been so. The controversy lasted for some time, and at last rather died out, or was allowed to drop, than brought to any satisfactory conclusion by the arguments or proofs advanced on either side. By the opponents of boat-racing the case was opened rather unguardedly by statements requiring a stronger array of facts than could be brought to support them when the call for proofs was made; by its defenders was met by the somewhat blunt rejoinder, "You don't know anything about it; you never lifted an oar in your life." The former forgetting that there is nothing so difficult to overcome as enthusiasm, *esprit de corps*, and, perhaps, prejudice; the latter forgetting that the effects of certain modes of exertion on certain organs and tissues of the human body may be sagely divined by a skilful and experienced physician or surgeon, without his ever having in his own person practically undergone such exertion.

As we have said, the argument dropped rather than was brought to any satisfactory conclusion, and if each side did not claim the victory, each stoutly denied that the other had won. Unto this day do we hear alarms sounded with reference to these races, again does paterfamilias feel nervous qualms at the intelligence that his son has betaken himself to the river. Again do non-rowing men console themselves for the want of river distinctions by the thought of their exemption from its risks and liabilities, and again do rowing men enjoy the *éclat* of having greatly dared for the reputation of their Colleges and University, with the secret conviction and comfort that the dangers they have run have been very slight indeed.

It was to close this open question for ever, and settle once for all this standing dispute which has many scientific aspects of great interest, that Dr. Morgan undertook the present work, recognising evidently to the full the standpoint selected by the disputants in the controversy, the one, their practical knowledge as experienced oarsmen, the other, his theoretical knowledge as a scientific surgeon; for, as the author informs us, his qualifications for the task are twofold:—

"As a physician to a large hospital, I have necessarily enjoyed large opportunities of gaining an insight into the laws which regulate our health, while my rowing experience began at Shrewsbury (where I spent many a pleasant hour on the Severn), and was matured at University College, Oxford, where I was for three years Captain of the John +, a boat which has often played a prominent part in the struggles on the Isis, and which has served as the training school for no fewer than ten of the crews which during the last thirty years have won the University Fours."

These qualifications certainly seem adequate to the task, and the plan pursued by Dr. Morgan also seems the best possible, albeit entailing enormous labour on, and demanding vast patience from, him. This plan was simply to institute a strict and exhaustive search after all the men who have rowed in these inter-University contests; to track them, as it were, to whatever part of the world they may have gone; this done, to get their own written testimony, if alive, and that of their friends, if dead, as to whether the part they played in these contests entailed any after evil results upon their constitutions and frames, and (if any) their nature and extent.

Considering that more than forty years have elapsed since the commencement of these friendly contests, and that between the years 1829-1869 twenty-six races have been rowed, giving for the crews of both Universities, and allowing for men who have rowed in more than one race, the gross number of 294 men, the task was a formidable one; but, we must add, has been as ably conducted to its conclusion as it was resolutely undertaken. The author has ascertained that out of these 294 men 245 are still living—39 having died: the time of their death and the ailment of which they died are carefully given by the author, and to this point we will return. He next tabulates the following results elicited by his inquiries:—

Benefited by rowing . . .	115
Uninjured „ . . .	162
Injured „ . . .	17

The *benefits* derived are somewhat vaguely stated, as indeed was to be expected when almost the only benefits that could be reasonably derived from such pursuits would be of a *general* nature; such as increase of strength and stamina, increase of energy to undertake, increase of power to undergo, physical exertion; increase of fortitude to encounter and to submit to trials and privations and disappointments. A goodly list of benefits when critically examined. *The uninjured* are those who in their replies to the author's queries state *negatively* the results of rowing upon their constitutions and frames; or, in the author's language, who merely say in general terms "that they never felt any inconvenience from rowing;" while the *injured* are they who state with less or more distinctness that their exertions proved harmful.

We must confess that this last item in the bill, the 17 injured, is at first sight a little startling, and so it must, we think, have appeared to the author, for he very carefully and minutely examines the cases so recorded, and some, we think, successfully dismisses as unreal; while others, we fear it must be candidly avowed, must remain as *bona fide* instances of injury. But is this a matter to be wondered at when the number of men who had been so engaged is taken into consideration? Is there any other pastime or pursuit in which grown men can take part, such as draws forth at the same time their bodily power and keenest emulations, which will yield a smaller percentage of evil? Would the hunting-field, would the foot-ball field, or even the cricket-field, if closely scrutinised?

The author tells us that during his inquiries on this subject he has written over two thousand letters. We can well believe it, knowing how unwilling many men are to reply to personal inquiries, and specially so when the inquirer asks after personal ailments. He has not however done himself justice in not giving us in his book a specimen of his letters addressed to his scattered correspondents; for in all cases of dispute, and contested evidence, it is always a matter of objection if the question as put indicates or leads up to the sort of answer desired; and when, as has been already said, scepticism on one side and *esprit de corps* on the other so strongly prevails, doubts may be entertained of the accuracy of some of the statements made in the correspondents' replies. But we think that it will be admitted that as a whole those replies are eminently satisfactory.

A circumstance quite noteworthy, however, strikes the reader who scrutinises the lists as tabulated recording the instances of *injured*, and we would be glad to hear some explanation or interpretation of what at present seems inexplicable. Thus out of the first six races only three men are recorded as injured, while out of the next four races nine men are so recorded, five being mentioned in one race—that of 1845—and two more in the race of the following year. Again occurs a period of comparative immunity from injury, only one case being instanced in the next seven races. Once more is the order changed, for in the following four races four men are recorded as injured, while in the five remaining races of the series no injury whatever seems to have been sustained. The author does not seem to have instituted any inquiry on this point, yet surely it is one worth investigation, seeing that it is this very matter of liability to injury which is the sole subject of dispute, to settle which is the avowed object of his book. Was this injury-rate affected by the mode of training of the crews, the physical calibre or age of the individual men composing them, by the severity of the contest itself, or by the character of the season when the men trained and rowed?

ARCHIBALD MACLAREN

THOMSON & TAIT'S NATURAL PHILOSOPHY

Elements of Natural Philosophy. By Professors Sir W. Thomson and P. G. Tait. Clarendon Press Series. (Macmillan and Co., 1873.)

NATURAL Philosophy, which is the good old English name for what is now called Physical Science, has been long taught in two very different ways. One method is to begin by giving the student a thorough training in pure mathematics, so that when dynamical relations are afterwards presented to him in the form of mathematical equations, he at once appreciates the language, if not the ideas, of the new subject. The progress of science, according to this method, consists in bringing the different branches of science in succession under the power of the calculus. When this has been done for any particular science, it becomes in the estimation of the mathematician like an Alpine peak which has been scaled, retaining little to reward original explorers, though perhaps still of some use, as furnishing occupation to professional guides.

The other method of diffusing physical science is to render the senses familiar with physical phenomena, and the ear with the language of science, till the student becomes at length able both to perform and to describe experiments of his own. The investigator of this type is in no danger of having no more worlds to conquer, for he can always go back to his former measurements, and carry them forward to another place of decimals.

Each of these types of men of science is of service in the great work of subduing the earth to our use, but neither of them can fully accomplish the still greater work of strengthening their reason and developing new powers of thought. The pure mathematician endeavours to transfer the actual effort of thought from the natural phenomena to the symbols of his equations, and the pure experimentalist is apt to spend so much of his mental energy on matters of detail and calculation, that he has hardly any left for the higher forms of thought. Both of them are allowing themselves to acquire an unfruitful familiarity with the facts of nature, without taking advantage of the opportunity of awakening those powers of thought which each fresh revelation of nature is fitted to call forth.

There is, however, a third method of cultivating physical science, in which each department in turn is regarded, not merely as a collection of facts to be co-ordinated by means of the formulæ laid up in store by the pure mathematicians, but as itself a new mathesis by which new ideas may be developed.

Every science must have its fundamental ideas—modes of thought by which the process of our minds is brought into the most complete harmony with the process of nature—and these ideas have not attained their most perfect form as long as they are clothed with the imagery, not of the phenomena of the science itself, but of the machinery with which mathematicians have been accustomed to work problems about pure quantities.

Poinsôt has pointed out several of his dynamical investigations as instances of the advantage of keeping before the mind the things themselves rather than arbitrary symbols of them; and the mastery which Gauss displayed over every subject which he handled is, as he said himself, due to the fact that he never allowed himself to make a single step, without forming a distinct idea of the result of that step.

The book before us shows that the Professors of Natural Philosophy at Glasgow and Edinburgh have adopted this third method of diffusing physical science. It appears from their preface that it has been since 1863 a text-book in their classes, and that it is designed for use in schools and in the junior classes in Universities. The book is therefore primarily intended for students whose mathematical training has not been carried beyond the most elementary stage.

The matter of the book however bears but small resemblance to that of the treatises usually put into the hands of such students. We are very soon introduced to the combination of harmonic motions, to irratational strains, to Hamilton's characteristic function, &c., and in every case the reasoning is conducted by means of dynamical ideas, and not by making use of the analysis of pure quantity.

The student, if he has the opportunity of continuing his mathematical studies, may do so with greater relish when he is able to see in the mathematical equations the symbols of ideas which have been already presented to his mind in the more vivid colouring of dynamical phenomena. The differential calculus, for example, is at once recognised as the method of reasoning applicable to quantities in a state of continuous change. This is Newton's conception of Fluxions, and all attempts to banish the ideas of time and motion from the mind must fail, since continuity cannot be conceived by us except by following in imagination the course of a point which continues to exist while it moves in space.

The arrangement of the book differs from that which has hitherto been adopted in text-books. It has been usual to begin with those parts of the subject in which the idea of change, though implicitly involved in the very conception of force, is not explicitly developed so as to bring into view the different configurations successively assumed by the system. For this reason, the first place has generally been assigned to the doctrine of the equilibrium of forces and the equivalence of systems of forces. The science of pure statics, as thus set forth, is conversant with the relations of forces and of systems of forces to each other, and takes no account of the nature of the material systems to which they may be applied, or whether these systems are at rest or in motion. The concrete illustrations usually given relate to systems of forces in equilibrium, acting on bodies at rest, but the equilibrium of the forces is established by reasoning which has nothing to do with the nature of the body, or with its being at rest.

The practical reason for beginning with statics seems to be that the student is not supposed capable of following the changes of configuration which take place in moving systems. He is expected, however, to be able to follow trains of reasoning about forces, the idea of which can never be acquired apart from that of motion, and which can only be thought of apart from motion by a process of abstraction.

Profs. Thomson and Tait, on the contrary, begin with kinematics, the science of mere motion considered apart from the nature of the moving body and the causes which produce its motion. This science differs from geometry only by the explicit introduction of the idea of time as a measurable quantity. (The idea of time as a mere sequence of ideas is as necessary in geometry as in every other department of thought.) Hence kinematics, as involving the smallest number of fundamental ideas, has a metaphysical precedence over statics, which involves the idea of force, which in its turn implies the idea of matter as well as that of motion.

In kinematics, the conception of displacement comes before that of velocity, which is the rate of displacement. And here we cannot but regret that the authors, one of whom at least is an ardent disciple of Hamilton, have not at once pointed out that every displacement is a vector, and taken the opportunity of explaining the addition of vectors as a process, which, applied primarily to displacements, is equally applicable to velocities, or the rates of change of displacement, and to accelerations, or the rates of change of velocities. For it is only in this way that the method of Newton, to which we are glad to see that our authors have reverted, can be fully understood, and the "parallelogram of forces" deduced from the "parallelogram of velocities." Another conception of Hamilton's, however, that of the hodograph, is early introduced and employed with great effect. The fundamental idea of the hodograph is the same as that of vectors in general. The velocity of a body, being a vector, is defined by its magnitude and direction, so that velocities may be represented by straight lines, and these straight lines may be moved parallel to themselves into whatever position is most suitable for exhibiting their geometrical relations, as for instance in the hodograph they are all drawn from one point. The same idea is made use of in the theorems of the "triangle" and the "polygon" of forces, and in the more general method of "diagrams of stress," in which the lines which represent the stresses are drawn, not in the positions in which they actually exist, but in those positions which most fully exhibit their geometrical relations. We are sorry that a certain amount of slight is thrown on these methods in § 411, where a different proposition is called the *true* triangle of forces.

It is when a writer proceeds to set forth the first principle of dynamics that his true character as a sound thinker or otherwise becomes conspicuous. And here we are glad to see that the authors follow Newton, whose Leges Motûs, more perhaps than any other part of his great work, exhibit the unimproveable completeness of that mind without a flaw.

We would particularly recommend to writers on philosophy, first to deduce from the best philosophical data at their command a definition of equal intervals of time, and then to turn to § 212, where such a definition is given as a logical conversion of Newton's First Law.

But it is in the exposition of the Third Law, which affirms that the actions between bodies are mutual, that our authors have brought to light a doctrine, which, though clearly stated by Newton, remained unknown to generations of students and commentators, and even when acknowledged by the whole scientific world was not known to be contained in a paragraph of the *Principia* till it was pointed out by our authors in an article on "Energy" in *Good Words*, October 1862.

Our limits forbid us from following the authors as they carry the student through the theories of varying action, kinetic force, electric images, and elastic solids. We can only express our sympathy with the efforts of men, thoroughly conversant with all that mathematicians have achieved, to divest scientific truths of that symbolic language in which the mathematicians have left them, and to clothe them in words, developed by legitimate methods from our mother tongue, but rendered precise by clear definitions, and familiar by well-rounded statements.

Mathematicians may flatter themselves that they possess new ideas which mere human language is as yet unable to express. Let them make the effort to express these ideas in appropriate words without the aid of symbols, and if they succeed they will not only lay us laymen under a lasting obligation, but, we venture to say, they will find themselves very much enlightened during the process, and will even be doubtful whether the ideas as expressed in symbols had ever quite found their way out of the equations into their minds.

TYNDALL'S FORMS OF WATER

The Forms of Water in Clouds and Rivers, Ice, and Glaciers. By John Tyndall, LL.D., F.R.S. (London: H. S. King & Co.)

WHATEVER comes from Dr. Tyndall's pen is sure to be vivid and clear. The present little volume forms no exception to this rule. It seems to have been composed partly in the form of popular lectures and partly as a sort of journal of a visit last year to the author's favourite holiday haunts among the Swiss glaciers. Very readable, it nevertheless betrays this composite origin, and wears more the aspect of a piece of book-making than probably its author himself could have wished. A wrong impression of the subject is created by the title, which though singularly happy in itself does not fairly describe the contents of the book. Such a title suggests an accurate and luminous discussion of the phenomena of evaporation and condensation, the growth and movements and disappearances of mists and clouds, the formation and distribution of rain and the laws regulating the rainfall over the globe, the meaning of frost, the birth and history of hail and snow, the circulation of water over the land with the ways and workings of brook, stream, and river, from mountain-peak to sea-shore, the architecture and the functions of snow-fields, glaciers, and icebergs—in short a kind of scientific poem, dedicated to the glory of that grand old element—water. Dr. Tyndall could write such a poem better than most men, and indeed it was with the expectation that he had attempted it that we opened this last volume of his. Out of the 192 pages 28 are devoted to clouds, rains, rivers, waves of light and heat, oceanic distillation and mountain condensers. The rest treat wholly of ice. So that if we may judge by the relative space devoted to the different forms of water, ice must be six times more important than all the rest put together. A less ambitious title, such as its author could readily suggest, descriptive of the fact that the book is a record of work, intellectual and corporeal, among the Swiss glaciers, would prevent the feeling of disappointment with which many a reader has no doubt come to the last page.

Dr. Tyndall did not intend, we suppose, that his book should be regarded in any other light than as a popular exposition of his subject, and would probably disclaim any place for it as a contribution of new facts and reasonings to our knowledge of glaciers. His narratives of last year's climbings and observations read very much like those of older ones with which he has already made us familiar. They are pleasantly written, and will convey to a reader, who has never seen a glacier, a picturesque notion of what he has missed. But surely it was not necessary to rake up again the Forbes-Rendu controversy, nor to renew the claims of Agassiz and Guyot. We could have wished, too, that while alluding to Mr. Mathews and other recent observers on ice-structure the writer had taken some notice of the attack upon his own theory by Canon Mosely and Mr. Croll.

OUR BOOK SHELF

Die Anwendung Des Spectralapparate von Dr. K. Vierordt. (Tübingen : H. Laupp, 1873.)

DR. VIERORDT has been endeavouring to found a quantitative spectrum analysis for bodies giving an absorption spectrum. His method consists in the use of a slit divided horizontally into two parts; one of these is adjusted to a certain width; the solution whose absorption is to be examined is placed opposite this, and in front of the other half is placed another solution of the same body but of a different strength, and the slit is then narrowed or widened as the solution is stronger or weaker until the absorption is the same in both halves of the spectrum. The width of the latter slit is then read off. By using a number of solutions of strengths varying decimally from the weakest possible to the strongest through which light will pass, curves are obtained and a solution of unknown strength can then be interpolated in the curve and its value ascertained. The solutions to be examined are, of of course, kept at a constant thickness. As the relation between the concentration of the solution and its coefficient of the absorption of light only remains constant within certain limits, solutions of the necessary dilution have to be employed and unknown solutions must be diluted to this point: the value is then found by calculation.

Tables for calculations of various kinds required are given, and the memoir is illustrated with lithographs of the working details of the divided slit. A number of specimen curves are also given. The memoir is well worthy the attention of all who have to estimate the strength of colouring matter.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Existence of Man in the Miocene

I HAVE received a letter from Mr. Edmund Calvert, in which he informs me that his brother, Mr. Frank Calvert, has recently discovered, near the Dardanelles, what he regards as conclusive evidence of the existence of man during the Miocene period. Mr. Calvert had previously sent me some drawings of bones and shells from the strata in question, which Mr. Busk and Mr. Gwyn Jeffreys were good enough to examine for me. He has now met with a fragment of a bone, probably belonging either to the Dinotherium or a Mastodon, on the convex side of which is engraved a representation of a horned quadruped, "with arched neck, lozenge-shaped chest, long body, straight fore legs, and broad feet." There are also, he says, traces of seven or eight other figures, which, however, are nearly obliterated. He informs me that in the same stratum he has also found a flint flake, and several bones broken as if for the extraction of marrow.

This discovery would not only prove the existence of man in Miocene times, but of man who had already made some progress, at least, in art. Mr. Calvert assures me that he feels no doubt whatever as to the geological age of the stratum from which these specimens were obtained.

Of course I am not in a position myself to express any opinion on the subject; but I am sure that the statements of so competent an observer as Mr. Calvert will interest your readers.

High Elms, March 23 JOHN LUBBOCK

Adaptation to External Conditions

THE curious modification of adaptation to external conditions in the case of the *Salamandra atra*, which I have more than once brought under the notice of naturalists, but which I myself first noticed under the direction of Prof. von Siebold, has been cited by Mr. Darwin ("Origin of Species," 4th Ed. p. 534) in confirmation of his views. I revert to it now for the sake of its illustration of a new and striking observation, which has excited the incredulity of several eminent naturalists in France—an incredulity, we may suppose, founded on their ignorance of the previous observation. The fact to which I called attention was this: The ordinary salamander, or Newt, is born in the water as a tadpole, and in the water it completes its metamorphosis. But the *Salamandra atra*, living high up in the mountains, with no pools in which to pass its tadpole existence, is born on the land, a completely formed animal; that is to say it passes through the tadpole stage while still within its mother's body. I have taken it from the gravid female in this tadpole state, and placed it in water, wherein it swam as if that were its natal element.

In the *Revue Scientifique*, No. 37, there has just appeared a brief account of some observations made by M. Bavay at Guadeloupe, from which it appears that the frogs, having in that volcanic island no marshes nor pools suitable for the early tadpoles, have adapted themselves to these conditions by passing through all the tadpole stages of metamorphosis while still in the egg. All these stages have been observed by M. Bavay; and whoever is familiar with the evolution of the ordinary tadpole before it quits the egg, will see that M. Bavay has observed only a modified form of the well-known process. The Guadeloupe frog is born as a frog, not as a tadpole; and this, paradoxical as it may seem to some naturalists who cannot dismiss traditional conceptions, is even less remarkable than the case of the *Salamandra atra*, because it is only an extension of the period of incubation, whereas with the salamander it is the substitution of viviparity for oviparity. How the presence of water leads to an acceleration of the birth, or the absence of water leads to its retardation, is an interesting point for investigation; whether retarded or accelerated, the finally-acquired structure is the same.

The Priory, March 22 GEORGE HENRY LEWES

Anticipations of Natural Philosophy

MAUPERTUIS

HAVING lately had occasion to examine the works of Maupertuis I, like Prof. Jevons, was struck by meeting with anticipatory glimpses of the modern theory of Natural Selection. The passage, given almost word for word by Lord Bolingbroke in the quotation made by Prof. Jevons, occurs somewhat incidentally in two parts of Maupertuis' writings; in the memoir alluded to ("Les Loix du Mouvement et du Repos, déduites d'un principe métaphysique"); and in the "Essay de Cosmologie," into which the memoir was expanded five years later (1751). In both these works Maupertuis is chiefly concerned with establishing his well-known metaphysico-mechanical principle of "The Least Action" ("La moindre Quantité d'Action"); and with deducing therefrom proof of the existence of God. But the doctrine of "The Survival of the Fittest" is more clearly discernible, and more than incidentally referred to, in his small physiological treatise, "Venus physique" (Œuvres, tome ii. ed. 1756). The whole of this work is not wanting in interest, but as bearing specially on the subject in question, I would mention the third, fifth, and last chapters of the second part. Chapter III. is entitled "Production de nouvelles especes." In it the most pronounced passage is perhaps the following: "Mais la sage Nature, par le dégoût qu'elle a inspiré pour ces défauts, n'a pas voulu qu'ils se perpetuassent; chaque père, chaque mère fait de son mieux pour les éteindre; les beautés sont plus sûrement héréditaires; la taille, et la jambe, que nous admirons, sont l'ouvrage de plusieurs générations, où l'on s'est appliquè à les former." Chapter V., called an "Essay d'explication des phénomènes précédents," is an attempt to explain the physiological processes at work in the preservation of the best types, and in the production of new forms. On the efficacy of these processes the author says: "L'expérience pourroit, peut-être, éclaircir ce point; si l'on essayoit pendant longtemps de mutiler quelques animaux de génération en génération, peut-être verroit-on les parties rétranchées, diminuer peu à peu; peut-être verroit-on les à la fin s'anéantir." The last chapter contains a summary of the whole work, and a number of "Doutes et Questions," propounded by the author. In one of these he asks, "Cet instinct des animaux, qui leur fait rechercher ce qui leur convient, et fuir ce qui leur nuit, n'appartient-il point aux plus petites parties dont l'animal est formé?" In another question Maupertuis puts forward a bold hypothesis as to the influence which the decomposed material of the dead animal organism might exercise upon plants, and through them upon the structure and character of the living organism.

In his *Système de la Nature* also (Œuvres, tom. ii. ed. 1756), Maupertuis combats the special creation theory of the origin of species, and advocates a doctrine, which may be called Natural Selection, the selective principle being placed in the ultimate elements of both organic and inorganic substances, of which elements "la perception est une propriété essentielle," and which "doués d'intelligence s'arrangent et s'unissent pour remplir les vues du Créateur."

Such are a few of the glimpses to be met with in the French philosopher, of the modern doctrine of Darwin and Spencer. Similar ones may not improbably be found elsewhere, but such "resultless tendencies," as the course of events has proved them to be, can in no degree detract from the merit and originality of those who have made of Natural Selection a well-substantiated and homogeneous theory. W. H. BREWER

Grace's Road, Camberwell, March 10

EMPEDOCLES

ON reading Prof. W. Stanley Jevons' interesting letter in this week's NATURE, I referred to my note-book, and found the following quotation, under the title of "Natural Selection," which shows that the opinion of Maupertuis is at least as old as Empedocles.—"Cette dernière opinion sert á expliquer les Idées d'Empédocle sur la production des animaux par des causes accidentelles. L'attraction et la répulsion des élémens donnèrent naissance dans les commencemens et par le seul effet du hasard, à des têtes sans cou, à des jambes sans corps, à des animaux moitié bœufs et moitié hommes, en un mot, à une foule de monstrés semblances. Parmi tous ces êtres, les uns étaient construits de manière qu'ils semblaient êtres doués de l'intelligence: ceux-là conservèrent la vie, et propagèrent leur espèce, mais ceux auxquels l'organe de la vie manquait, retombèrent dans le chaos, d'ou ils étaient sortis." ("Histoire de la Medécine," par Kurt Sprengel, vol. i. p. 249.) Sprengel gives the following references:—Aristotle, Physic. Lib. ii., c. 4, p. 465., c. 8, p. 470. Owing to my distance from a public library I have not hitherto had an opportunity of referring to Aristotle; but as Prof. Jevons is more favourably circumstanced, I hope he will consult the original, and if he finds anything which throws further light upon this interesting question, that he will report it to your readers.

Although, as Prof. Jevons remarks, the introduction of the notion of *chance* is erroneous, the speculation shows how thoroughly the Greek Atomists had banished from their explanations of phenomena all reference to first and final causes, anticipating in this respect the modern conception of science. I cannot deny myself the pleasure of quoting the weighty judgment of Bacon upon this point:—"And therefore the natural philosophies of Democritus and others," says Bacon, "who allow no God or mind in the frame of things, but attribute the structure of the universe to infinite essays and trials of nature, or what they call fate or fortune, and assigned the causes of particular things to the necessity of matter without any intermixture of final causes, seem, so far as we can judge from the remains of their philosophy, much more solid, and to have gone deeper into nature, with regard to physical causes, than the philosophy of Aristotle or Plato; and this only because they never meddled with final causes, which the others were perpetually inculcating." (Advancement of Learning, Book iii. chap. iv.)

Waterfoot, March 8 JAMES ROSS

ARISTOTLE

IT is interesting, as Mr. Jevons says, to observe such traces as are to be found in history of theories more or less anticipating the principle of natural selection. But if the instance he cites from Maupertuis fairly represents the last century in this matter, it is chiefly of interest as showing what a little way it is possible to travel on certain roads in twenty-two centuries: for Aristotle discusses the same theory in his "Physics" (ii. 8), and appears to attribute it to Empedocles. "It may be a question," he says, "whether physiological effects which seem to be due to final causes are not really accidental. An organism survived, we may suppose, if it happened to be as a whole constituted in a suitable manner; that is, in a manner in which it would have been constituted by design; organisms otherwise constituted perished and perish still, like the βουγενῆ ἀνδρόπρωρα of Empedocles." Now, except that his monsters are certainly not quite so monstrous, I do not see that the "Flattener of the Earth" gets beyond that. At any rate he lags behind Lucretius, who adopts the same theory of "discriminative destruction" (v. 837–877), but applies it, as Mr. Munro points out (on line 855), not merely to monsters but to "regularly organised creatures," either not so gifted as to protect themselves or not so valuable as to be protected by man.

This is, as far as it goes, a theory of natural selection. It is a theory of the survival of the fit, absolutely; but not being a theory of the preponderant survival of the fitter, and not taking adequate account of inheritance, it is not a theory of evolution. Indeed, though Lucretius recognised a constant change in the conditioning circumstances, and therefore in the organisms conditioned (828–836), it was to account for the stability of species that he called in natural selection and not to give a clue to the laws of their variation. That is the direction in which there must have been most room for progress; and traces of such progress may be to be found. Has Mr. Jevons tried Gassendi? C. J. MONRO

Hadley, Middlesex

Fossil Cryptogams [*]

I DO not propose at present to controvert in detail all the positions taken up by my friend Prof. McNab in his brief communication to your pages on "Fossil Cryptogams" (vol. vii. p. 267), because the time has not yet arrived for doing so. Much more detailed information respecting the subject which yet awaits publication must be had before it can be discussed in a satisfactory manner. I merely wish to avoid leaving the impression, by my silence, that I either admit his supposed facts or accept his inferences. When his paper, to which he refers, was read in Edinburgh, specimens of sections of Calamites of various ages were sent down by me for the purpose of being exhibited to the Botanical Society. This was done by Prof. Dickson, who at the same time expressed his preference for my views over those of Dr. McNab, as is stated in the officially published notice of the meeting in question. Since then I have received a kind letter from Dr. Balfour, who has carefully examined the specimens referred to, and who also expresses a similar conviction. I think that I have unmistakeable proof of the circumferential growth of Calamites, which Dr. Macnab denies, in specimens of large size, and in which the exogenous zone is of great thickness.

Prof. McNab speaks of "the moist nature of the soil in which the Calamites must have grown," as probably causing a different mode of growth in them, to that "circumferential" one which he admits has probably taken place in Lepidodendra, Sigillariæ, and Dictyoxylons; but I beg to suggest that we have no reasons for thinking otherwise than that these plants grew side by side, and under precisely the same physical conditions, hence the "moist soil" of my friend is an assumption. This close association of Calamites with Sigillariæ was demonstrated and commented upon by Mr. Binney many years ago. Dr. McNab further separates Lepidodendron from Sigillaria and Stigmaria, placing them in different groups. When he receives my third memoir in the Philosophical Transactions (which is printed but not yet circulated), he will see how utterly this plan of procedure is opposed to the facts. I contend that Sigillariæ are virtually Lepidodendra, and that Stigmaria is equally the root of both. As to the location of my old, but now abandoned genus, Dictyoxylon, the more I study it the less I feel competent to fix its true place amongst the Cryptogams. But notwithstanding Dr. McNab's idea as to its coniferous affinities, I venture to affirm, from a prolonged study of a cabinet full of specimens, that its woody axis is not one bit more exogenous than those of Calamites and of *matured* Lepidodendra. The fact is that whatever the vessels of these various exogenous woody zones signify, they must stand or fall together. They are either all ligneous or they are all cortical. I think that my forthcoming illustrations of the *bark structures* amongst the Burntisland Lepidodendra, as well as of our Lancashire specimens, will show that all the elements which Dr. McNab finds in Lycopodium Chamæcyparissus are present, in their proper places, the schlerenchyma of the hypoderm being especially well represented, yet it is precisely this hypoderm with which Dr. McNab believes my exogenous layer to correspond. There is one if not two distinct layers of cortical parenchyma between this schlerenchymatous layer and my ligneous zone, which latter is so magnificently represented in these plants.

The intimate structure of these latter layers, whether we regard the forms and arrangements of the entire woody wedges or that of their component tissues, is so identical in the two cases of Calamites and Lepidodendra, that an active imagination alone can make the one axial and ligneous, and the other cortical. Dr. McNab draws a distinction between vessels representing ("feebly") the fibro-vascular bundles of the living Equisetums, in the Calamites, and the more external portions of each woody wedge, which he regards as representing the hypodermal schlerenchyma of Mettenius. I unhesitatingly avow that there is no ground whatever for this arbitrary separation. He is putting asunder things which have been joined together from the beginning of time. The tissues in question are as identical in their structure as they are uninterruptedly continuous in their arrangement.

Whilst I am thus opposed to Dr. McNab both on questions of fact and of inference, I feel obliged to him for calling my attention to this possible explanation of the facts, even though after a careful study of his views I feel constrained to reject them so far as the interpretation of Calamites are concerned. On the questions relating to Meristem growths, we are much nearer to mutual agreement, and I accept thankfully his admission of the coniferous affinities of Dictyoxylon, not because I am prepared to recognise any specially close coniferous relationships, but because Dr. McNab's idea necessarily involves an admission of the existence of exogenous features in these plants; yet I contend that the Dictyoxylons are neither more coniferous nor more exogenous than most of the other Cryptogamic carboniferous stems which exhibit equally strong proofs of a similar exogenous growth. But I again repeat that we shall not be in a position to grapple philosophically with these problems until all the results of my prolonged researches are published. This is being accomplished as rapidly as my limited leisure admits of. When completed, I shall be quite prepared to enter, if necessary, and in a friendly spirit, upon the entire controversy.

W. C. WILLIAMSON

Owens College

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[*] We regret that the insertion of this letter has been so long delayed in consequence of the great pressure upon our space.

Leaf Arrangement

AFTER reading Dr. Airy's paper on Phyllotaxis (NATURE, vol. vii. p. 343), I cannot see that we are at all nearer than before, any satisfactory explanation as to the inherent cause of it. Let the question be put thus:—If we can conceive, as all will admit, the possibility of leaves being scattered anyhow along a branch, why are they not so, but in some strictly mathematical order? Any disturbance in that order is usually so slight and trivial (due apparently in part to the *conical* nature of the axis, and unequal growth or slight twists; and which thereby cause certain leaves to assume slightly wrong positions), that it does not destroy the fact that they absolutely are arranged, and can be represented, *mathematically*.

In my paper on the angular divergences of the Jerusalem artichoke (Linnean Trans. vol. xxvi. p. 647), I pointed out that two questions might represent all that is required to be solved. (1) That if a leaf be selected as No. 1, then No. 2 lies within a certain arc, viz.:—120°—180° from No. 1, for the ordinary series of fractions, and which it does not transgress—why is this? (2) If we allow that arc—why does the second leaf not assume *any* spot, but is rigidly confined to a certain angular distance from the first?

I cannot think with Dr. Airy that "the way in which all the spiral orders may have been derived from one original order [was] by means of different degrees of twist in the axis." For if we take a piece of round elastic as he describes, with balls fixed according to some spiral arrangement—say $\frac{2}{5}$—then the successive balls will lie at an angular distance of 144°; and if No. 1 be fixed and we twist the indiarubber at No. 2, we may cause it to make a complet rotation if we choose.

If, now, his idea of "twist" be admitted as a *vera causa* of phyllotaxis, we may ask, *what causes the twist to be just so much and no more as to make* No. 2 *pass through* 9° (the angular divergence of $\frac{3}{8}$ being 135), so as to pass into the next $\frac{3}{8}$ arrangement? To say that some such point is a "position of maximum stability" seems to me to give a fictitious importance to the idea of twist, for the expression conveys no really explanatory meaning at all.

Again, to admit that it does not accurately hit the right place, and is in consequence more like Nature, is equally delusive, for Nature is quite accurate enough to be represented mathematically, whereas the positions taken up by the balls must be arbitrary, or at least in proportion to the twist given by the hand—a perfectly arbitrary force? Moreover he appears to overlook the fact that if an axis becomes twisted the *fibres* will be twisted also, but they are not so; the elastic band he adopts would, if it were a pliant shoot, contort the vessels and wood fibres, a condition not obtaining in nature.

Nor can I agree with him in deducing all the members of the series from $\frac{1}{3}$. My experience leads me to infer they are derived from *opposite* leaves, such as one finds in the cotyledons. In the Jerusalem artichoke opposite leaves are frequently succeeded by $\frac{2}{5}$; and this is obtained by the pair of leaves, next above the strictly opposite pair, converging to one side, the next pair do so still more, when it will be found that the $\frac{2}{5}$ arrangement will be henceforth established; the internodes having become more and more developed at the same time.

I strongly suspect the original arrangement to have been whorled and quincuncial. This is at least very abundant, if not universal, in coal plants. The whorls may have subsequently become reduced to fours, threes, and twos or decussate. We see this tendency to symmetrical reduction in many existing plants, *e.g.* stamens and carpels of *Cruciferæ*: *Circæa* as compared with *Epilobium*; the stamens of *Geranium* as compared with *Erodium*. Where the reduction has been unsymmetrical, I suspect it has been due to insect adaptation : as in di-dynamous stamens.

As soon as decussate leaves are secured, then we possess the basis for all ordinary leaf-arrangements.

Dr. Airy alludes to non-existing orders, $\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{9}$, $\frac{4}{11}$, but in the Jerusalem artichoke the secondary series $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$, $\frac{3}{11}$, $\frac{5}{18}$, occurs frequently, and arises from the breaking up of "tricussate" whorls in an exactly similar manner to the primary series, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, &c., arising out of opposite leaves. On the other hand spirals do not easily, if ever, return to whorls. If any one will notice how curiously the above is executed in the Jerusalem artichoke, he will see that there is evidently some power at work in the plant which, as it were, compels the spiral to form, and to form mathematically, will be convinced, I am sure, that a "twist" is very far from being the cause—there being none whatever in the cases mentioned above : and further, when whorls break up, the leaves are at first quite irregular, but they gradually "right themselves," acquire the proper angular divergence, and then form some member of the spiral arrangements to perfection.

GEORGE HENSLOW

Flight of Projectiles

IN reply to the letter of "W. Hope," in NATURE of March 13, I request permission to state that by a *simple* formula, I meant one that would be easily understood. I did not intend the word simple to be taken strictly in its mathematical sense.

It is easy for Mr. Hope to employ symbols to represent the initial velocity, angle of elevation, or any other additional particular he may consider necessary for the solution of my problem.

No one possessing the most elementary knowledge of the theory of projectiles can be ignorant of the disturbing elements to which your correspondent refers, or of others to which he makes no allusion. But these cannot be accurately estimated, and, therefore, must necessarily be neglected in a theoretical investigation. I do not anticipate that they will be found to vitiate the results of theory to the extent Mr. Hope supposes.

In the practical application of the formula for which I have asked, the numerical values of the general symbols, would be the *mean* of carefully conducted experiments. Thus the trifling variations arising from slight differences in the charge, the amount of fouling, or other causes, would be reduced to a minimum. The variations in the force and direction of the wind would often neutralise each other. For these reasons I cannot agree with Mr. Hope in thinking that the calculation would be either "useless or deluding," on the contrary I believe it would be valuable as indicating a mean deflection, about which the experimental deflections would be found to group themselves.

Of one thing I am certain, that it would enable us to bring home to the soldier the great effect of wind in deflecting the bullet, and perhaps it might assist us in dispelling the notion of absurdity which is inseparably associated in his mind with the effort to hit something by aiming at nothing. In accomplishing this one of the greatest obstacles to the development of skill in rifle-shooting would be removed.

If Mr. Hope will kindly supply me with the formula which I have asked for, I can assure him that however lightly he may appreciate the results of his labours, by me, at least, they will be valued, and, I venture to hope, made practically useful. Surely he cannot be in earnest in denouncing all theory which approximates to, but does not exactly accord with practice, as "bastard science, or pedantry." If this *dictum* be sound, I can only say it would be easy to show that a great deal of the science of our day, gunnery science in particular, is spurious.

General Didion, a high authority, did not consider my problem unworthy of investigation. In the *Cours Elementaire De Balistique*, he has given a solution which I regret is rather too complicated for my purpose. I should imagine that he would be the last person to expect his theory to afford more than a rough approximation to the results of practice. Hence I conclude that in publishing his calculation for the benefit of the French army, he could have had no conception that his science was "bastard science, or pedantry," and must have been unconscious what a "mischievous unpractical pedant" he was.

ROBERT REID, Sergeant-Major

School of Musketry, Hythe, March 17

Deep Sea Soundings near the Equator

THE following extract from a letter of the captain of the school-ship *Mercury*, occupied at present in taking deep-sea soundings under the orders of the Board of Commissioners of Public Charities and Correction of New York, has been sent to me by General Bowen, of that Board, who takes much interest in the subject. It will doubtless be gratifying to many of your readers :—

"Our Casella-Miller deep-sea thermometer worked admirably. This beautiful instrument stood the test at a depth of 2,040 fathoms, two miles north of the Equator, in longitude 22° 16′ W., when it indicated a temperature of 35° F. ; at 1,000 fathoms 38° ; at 400 fathoms 41° ; at 300 fathoms 44° ; at the surface 81° ; in the air 80°..

"On our track from the Canary Islands to Rio we found the temperatures at uniform depths to vary about 2°. Our specimens of the bottom from the volcanic region differ in every respect from those obtained in other parts of the ocean."

JOHN WM. DRAPER

University, New York, March 6

SURVIVAL OF THE FITTEST

THE doctrine of the "survival of the fittest" must be strangely understood in some quarters. The American papers report Prof. Agassiz as having expressed himself in this wise at a recent meeting of the Massachusetts State Board of Agriculture, of which he is a member :—"I do not know how animals originated ; a brilliant imagination that of Darwin ; a very necessary faculty in the scientist. The sense I know too well to misquote him. Hasty generalising of observation is Darwin all over. Natural selection is out of generation. Natural necessity, what is it? Do we find that only the strong beget families? *Observe plants at the foot of the White mountains, where are large trees, and so up to the summit, where they are mere shrubs.* The weak may and do survive as well as the strong. Ignorance lies at the base of the discussion."

Probably no one naturalist, however eminent, can be expected to know everything, or even all simple things. Can it be possible that Prof. Agassiz supposes (as his argument seems to require) that the dwarf trees in question grow and survive near the top of the mountain, *notwithstanding* they are not the fittest, rather than *because* they are the fittest, for the conditions? And does he conceive the doctrine of natural selection to be founded upon some idea of an abstract fitness, irrespective of the conditions, and not upon the survival of the fittest under and in consequence of the conditions? Surely the argument brought against the doctrine is a good illustration in its favour, only an extremely simple and elementary one.

We never could quite comprehend why Prof. Agassiz should give himself so heartily and persistently to the work of demolishing the doctrine of the derivation of species, in all its forms, considering how large and honourable a part he has himself taken in laying the foundation upon which the modern doctrine has been built. Of these foundations none is stronger than the capital one, generally supposed to be established by him, that the succession of species in time corresponds mainly with that in systematic rank, and is also somehow paralleled in the development of each individual of the higher ranks. So that, in view of his continued but unsuccessful efforts to drive the incoming doctrine out of the land, we could imagine him addressing his own important discoveries in the words used by Balak to Balaam : —"What hast thou done unto me? I took thee to curse mine enemies, and behold, thou hast blessed them altogether."

SUB-WEALDEN EXPLORATION.—SECOND QUARTERLY REPORT

A FRESH survey of the Lower Wealden beds in eastern Sussex by the officers of the Geological Survey Department has quite recently been made. The whole district has been recently visited by Messrs. Bristow, Topley, and Drew, and it has been decided to sub-divide the strata hitherto known as the Ashburnham beds into two divisions.

The upper portion, consisting of the mottled clays and shales, will henceforth be called the Fairlight beds, while the lower portion, consisting of shelly limestone intermixed with calcareous shale and *gypsum*, will retain their old title; unless (as is confidently anticipated) they will be found to represent the Purbeck strata, in which case they will be known as the Sussex Purbecks. In reference to our own immediate object, this recent survey has established beyond doubt that the site of the boring is by far the best that the county of Sussex presents for the purpose.

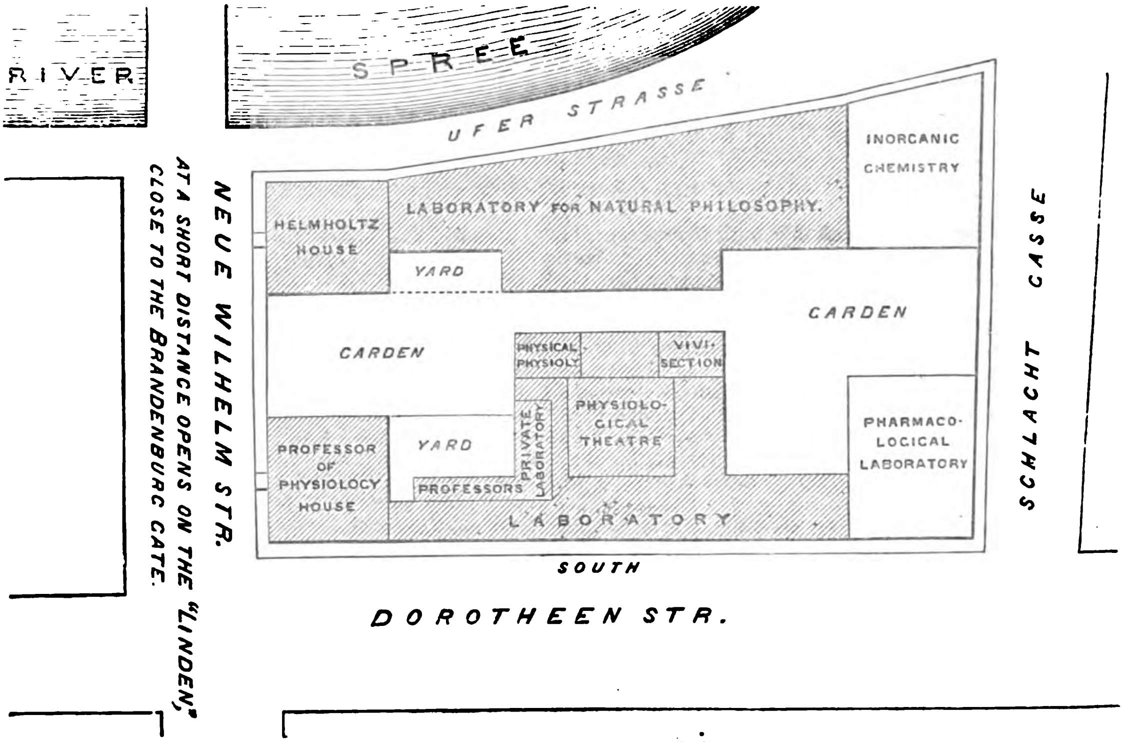
Quite unexpectedly, on January 28, at a depth of 131 feet, a stratified mass of pure white crystalline gypsum (statuary alabaster) was reached. This proved to be over 4 feet in thickness; it was succeeded by 10 feet of gypseous marl; then by 3 feet more of alabaster. Afterwards, we passed through 15 feet of gypsum (more or less impure) varied by seams of crystals of selenite. This discovery has been most opportune. No such accumulation of gypsum was ever met with in Sussex before; and it is some consolation to know that our labour has not been all labour in vain: gypsum is a material which is commercially valuable.

Geologists may therefore inquire, "Where are we now?" The reply is given with caution, and under correction (as the shale seems singularly free from fossils), but as blocks of gypsum are found in the lower strata of the Purbeck series, we assume we are near the base of that formation, and may with some reasonable confidence expect to be able to announce before another quarter is over that we are through these problematical beds, and into the Portland series or some subjacent formation.

The question of Finance begins to excite some anxiety in the mind of the treasurer. The amount required for machinery, sheddings, &c., has more than doubled the original estimate. Coals, tools, and labour, are each dear, and likely to remain so. The difficulty of access will greatly add to the original estimate of expenses. A large portion of our promised aid is given on conditions which render it unavailable at present.

If 200*l*. could be raised shortly, it would enable the Finance Committee to authorise the call of the second 1,000*l*.; and till this is done we are approaching insolvency. If each existing subscriber would kindly undertake to bring the matter under the notice of some neighbour or friend, we should not only soon raise all we want at present, but be relieved from anxiety for the ultimate prosecution of the enterprise.

We have nothing to do with the commercial value of our present or future discoveries; this will be freely given to those who can utilise it. We can only ask for aid from those who will "give, hoping for nothing again," except scientific discovery.



Plan of Physiological Laboratories, Berlin

THE NEW PHYSIOLOGICAL LABORATORIES AT BERLIN*

THE building of the new laboratory will begin on April 1. The plans are almost ready, and a most glorious place it will be, undoubtedly the finest physiological laboratory as well as the largest which was ever dreamt of. Besides the large theatre, and every possible accommodation for the lectures, it will contain rooms for collections, for a library, a smaller class-room, apartments for three assistants, lodgings for the servant and his family, &c. Then, there are five distinct laboratories most scientifically connected; (1) for physiological chemistry; (2) for physical physiology; (3) for vivisections; (4) for microscopical and embryological investigations. To this laboratory is added a complete aquarium, in which it is hoped to be able to keep all sorts of marine and fresh-water creatures. (5) The private laboratory is organised so as to afford opportunities for every kind of physiological inquiry, so that future professors will feel at home in it, whatever may be their peculiar branch of physiological research. Then, of course, there are dark chambers looking to the south for optical experiments, rooms for a respiration apparatus, and all sorts of stables, an aviary, a ranarium for the summer, and one for the winter, &c. There is to be a dwelling-house close by, in fact so connected with the laboratory that from the study a lobby and a flight of stairs lead to the private laboratory. The House has been designed entirely according to the English fashion, and wonderful to say, hitherto has not yet met with serious opposition from the architects and the authorities. On the same premises there will be (1) Helmholtz's laboratory and dwelling-house; (2) a laboratory for inorganic chemistry; (3) one for pharmacology, under Leibreich. The accompanying sketch will give an idea of the whole. It covers an area of 4½ acres. The style of builaing is to be magnificent, much more so than is desirable, because the costliness of the establishment increases the responsibility; but now that they are at it, they do not care for ever so many hundred thousands of dollars. All around the buildings, there will be an area, after the English plan, in order to mitigate the tremor occasioned by vehicles. In the Neue Wilhelmstrasse and the hitherto very nasty lane called Schlachtgasse there remains an open space facing the streets, so that the gardens intervening between the two great masses of building get as much light and air as is possible in the town. After all we are not so exclusively military as it may seem at a distance, and some of the French millions find their way into a scientific channel.

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* Extract from a letter communicated to us by Dr. Bence Jones.

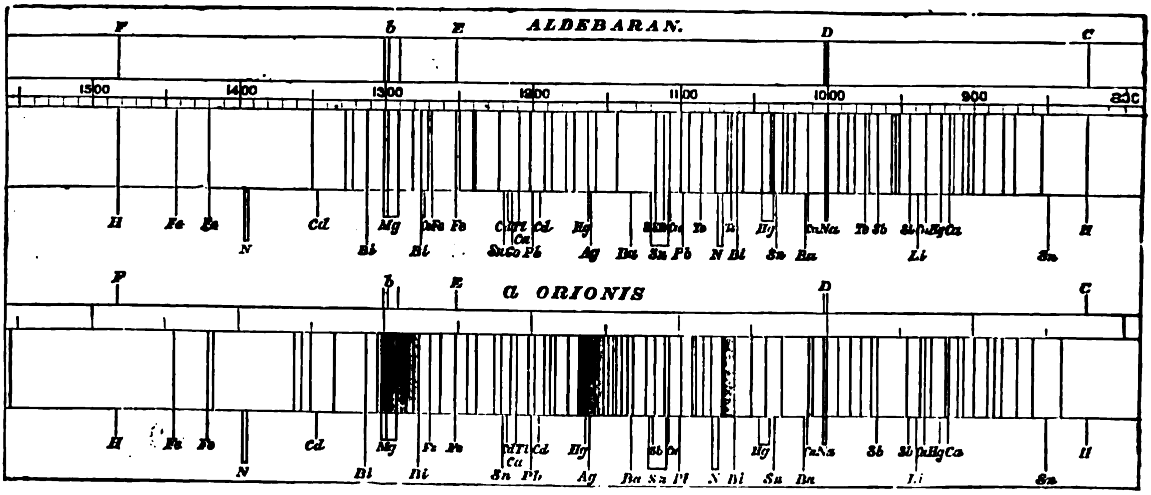


FIG. 34—.Spectra of Aldebaran and α Orionis. (Huggins and Miller.)

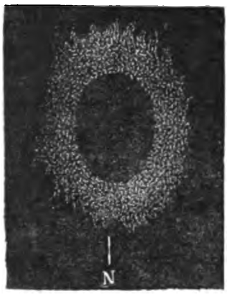


FIG. 35.

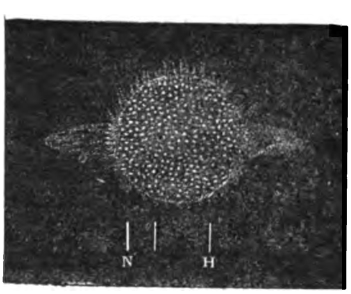


FIG. 36.

Fig 35.—Ring Nebula in Lyra, with its spectrum. Fig. 36.—Planetary Nebula in Aquarius, with its spectrum.

ON THE SPECTROSCOPE AND ITS APPLICATIONS

VI.

IN the first place, then, what does the spectroscope tell us with regard to the radiation from the sun and the stars? And here I ask you to neglect and banish from your minds for a time any idea of those dark lines in the solar spectrum that I drew your attention to on a former occasion. I hope I shall be able to explain them satisfactorily to you afterwards, but for the present I wish you merely to take the fact that our sun, but for the dark lines, would give us a continuous spectrum. The spectrum of the stars is very much like the spectrum of the sun. In Fig. 34 is seen a representation of the spectra of two stars, α Orionis and Aldebaran, mapped with the minutest care by Dr. Miller and Mr. Huggins.

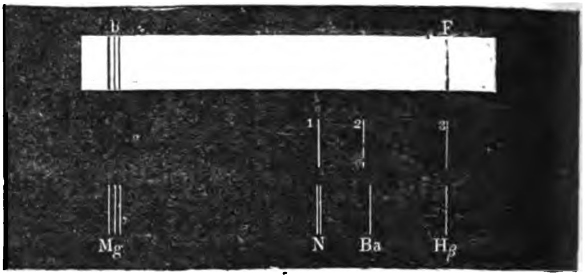
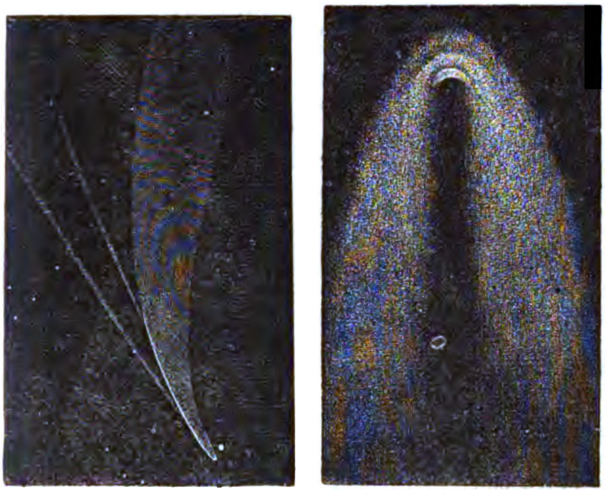


FIG. 37.—Spectrum of the Nebulæ.—1, 2, 3, lines observed. Above, the solar spectrum is shown from b to F; below, the bright lines of magnesium, nitrogen, barium, and hydrogen, in the corresponding part of the spectrum.

In both cases we should have a continuous spectrum but for the presence of the dark lines. I think you will see in a moment what I am driving at. Suppose the sun or stars composed of only sodium vapour, for instance, it is clear that their light analysed by the prism would give us no great indication of a continuous spectrum, we should merely get one bright line in the orange. But neglect the dark lines for a moment: dealing merely with the continuous spectrum of the sun and star, it shows that we have a something, whether it be solid or liquid, or whether it be a dense gas or a vapour, competent to give us a continuous spectrum. So we are justified in assuming that sunlight and starlight proceed from the incandescence of a solid, a liquid or a dense gas or vapour. Again, suppose that instead of looking at the sun or the stars we observe the moon, as Fraünhofer did, as has been before stated, what will happen? We get a second edition of sunlight, in exactly the same way as we should get a second edition of the sunlight in the case of a reflection of it from a mirror; and therefore, if proof of such a thing were needed, the spectroscope is perfectly competent to show us that the moon gives us sunlight second-hand. The same in the main with Jupiter, Venus, Mars, and the other planets. If we study them and observe the dark lines we find that the lines which we observe are generally the same as those which we find in the spectrum of the sun. There are other points to which I shall have to draw your attention on a future occasion, but on the whole, the teaching of the spectroscope is, that all those planets are lit up by sunlight as we know them to be.

But we have not yet exhausted the wonders of the celestial field; we have dealt merely with the sun and moon, the stars and planets. What about the nebulæ, those strange weird things, dimly shining in the depths of space, both to the eye and in the telescope obviously and distinctly different from anything in the shape of the sun or stars? The appearance of these peculiar bodies is sufficient to show us that we have here something very different from the sun or moon. What is it? You all know as well as I do that ever since nebulæ were discovered mankind have wondered at them, and wanted to know what they were; and you are also aware that it was not settled and could not be settled before the advent of the spectroscope, but that it could be settled in five minutes after that event. Mr. Huggins, who first observed the spectrum of a nebula, found that, instead of the continuous spectrum with which you are familiar in the case of the sun and the stars—always asking you to neglect the Fraünhofer lines, which I shall explain afterwards—the light which he got from the nebula consisted merely of three lines. He was exceedingly astonished, so much so that he thought the instrument might be out of order. However, it became perfectly clear to him in a very short time that there was no mistake at all, and that all that the light which came from the nebula could do was to give him these three faint lines. No doubt you have anticipated my explanation. The nebulæ are composed of tenuous gases or vapours. After what I have said about the way in which the spectroscope at once picks out the difference between a solid or liquid, and a vaporous or a gaseous body, you will see at once that these three bright lines indicate that the nebulæ, instead of being composed of solid, liquid, or densely gaseous bodies—instead of being like the sun or stars—are really composed of rare gases or vapours. Mr. Huggins was enabled, in fact, to determine the gas in one instance, for one of the lines he found was coincident with one of the principal lines in the spectrum of hydrogen one of the other lines possibly being due to nitrogen. And now comes another extremely important point, showing the importance of studying the most minute changes in gaseous spectra, for Mr. Huggins, who knew the spectrum of hydrogen and the spectrum of nitrogen well, and who knew how extremely complicated those spectra are at times, was much astonished at finding only one line of hydrogen and one of nitrogen, and attempted to account for the singleness of the lines, first, by assuming a condition of the gas different from anything we meet with in our laboratories, and again by assuming an absorbing medium in space. But after Dr. Frankland and myself had made some observations on the spectra of hydrogen and nitrogen, we found it was perfectly easy to obtain, and sometimes when one did not want it, a spectrum of hydrogen or of nitrogen giving only one line, or nearly so; so that by comparing the conditions which were necessary to obtain these conditions in our tubes with the conditions of the nebulæ, it was quite possible to make at all events a rough guess at what is the constitution of the nebulæ, so far as pressure or molecular separation goes. We find, for instance, this single line of hydrogen, and a nearly single line of nitrogen, when the pressure is so slight that you would say that the tube really contained nothing at all, and when, moreover, the temperature is comparatively low. Now, not only is this a fact, which we are quite prepared to assert, merely on the evidence rendered us by these tubes, but I think you will acknowledge that it is entirely in accordance with everything we know astronomically on this subject.



General view. Head and envelopes

FIG. 38.—Views of Donati's Comet.

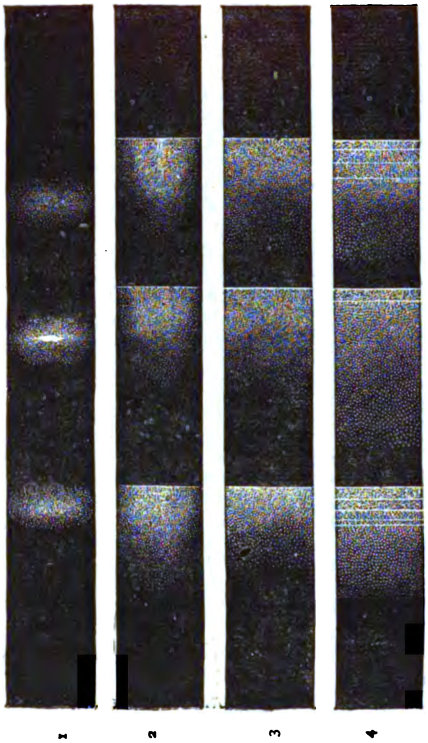


FIG. 39.—1, Spectrum of Brorsen's Comet; 2, Spectrum of Winnecke's Comet; 3, Spectrum of Carbon in olefiant gas; 4, Spectrum of Carbon in olive oil. (Huggins.)

For the next application of the spectroscope in this direction, let us take a comet. The appearance of a comet is probably well known to many, who will recollect the form of Donati's comet. Although, as you know, that comet appeared only about ten years ago, unfortunately it came too early for us to learn anything about it by means of the spectroscope. We have, first of all, an extremely bright nucleus; then a kind of semilune of greater brilliancy than the rest of the head; then what is called the coma, and the tail. The question which the spectroscope had to put to the comet was—of what is the nucleus composed, and of what is the tail composed. Prof. Donati, and Mr. Huggins especially, to whom we owe so much for his work in this direction, has made some observations on two small comets—I am sorry they were not larger—with considerable success. He found that in the comets he examined, the head gave out a light which very strongly indeed resembled the spectrum of carbon vapour. The spectrum of carbon taken with the spark in olive oil and in olefiant gas differs slightly; the spectrum as obtained from the latter consists of three bands or waves of light, which commence tolerably bright and sharply on the red side, and become gradually fainter towards the more refrangible side. These bands are severally situated in the beginning of the green, in the true green, and in the blue portions of the spectrum. Mr. Huggins has also observed the spectrum of Encke's comet, and has confirmed the result that he previously obtained, viz., that the spectrum of the comet is identical with the spectrum of carbon, as taken in a hydrocarbon. I should like to draw your attention, if there were time, to the way in which these spectra of the carbon spark taken in oil and in olefiant gas, differ.

I have not yet completed all I have to say on the subject of radiation. If, as we have already seen, we take a tube containing incandescent hydrogen and pass a series of intense electric sparks through it, we see that it gives out a red light, which may remind you of some other specimens of radiation which is supplied us by the skies. I allude to the red prominences which are seen around the sun, not in ordinary times, but when the sun is eclipsed. This representation gives you a good idea of what really is seen when the sun is eclipsed, when we have as it were a black sun instead of a bright one, which is really nothing, but the body of the moon. Around this we have a ring of light, which is called the corona, and here and there in this corona we have what are called red flames and red prominences. These red prominences have also on closer observation been found to be only local aggregations or heapings up of a red layer which surrounds the outer edge of the sun. Here, then, it was quite possible that if the newly invented spectroscope were set to question these things, we should see at once whether they were solid or liquid, or whether they were gaseous or vaporous. If we got a continuous spectrum from these red things, we should know that they were solid, or liquid, or densely gaseous. If, on the contrary, we got a bright line spectrum we should know we were dealing with a gas or vapour. You also see that, as the light is red, the chances were that they were not solid or liquid, and then you further see that if the things do consist of a light which does give us lines, a determination of the exact position of the lines, and a comparison of these positions with those of hydrogen, sodium, magnesium, barium, or anything else, would teach us what these things were.

J. NORMAN LOCKYER

PROF. FLOWER'S HUNTERIAN LECTURES

LECTURES XIII. XIV. XV.

TAPIRIDÆ. The geographical distribution of the existing members of this small order is very peculiar, they being confined to the Malay Peninsula, Sumatra, and most of South America. Lund has found their remains in the Post-pleistocene caves of Brazil; they have also been obtained in abundance from similar deposits in North America, and these can hardly be distinguished from those at present existing; in China likewise Pleistocene Tapir's teeth have been found. In Europe during the same time they do not seem to have existed, although Elephants and Rhinoceroses were abundant. In the Pliocene and Miocene, Tapirs are not unfrequently met with at Eppelsheim, Auvergne, and elsewhere; perhaps they originated in Europe, and thence spread east into Asia, and on to America. Respecting their anatomical peculiarities, the teeth are forty-two in number, the anterior lower premolar being absent; the molars and premolars are much alike, forming a uniform series; the incisors are smaller than the canines, they have a small cingulum. The molars are a modification of those of Lophiodon, the transverse ridges are very prominent, and the cusp of the cingulum is less developed. The lower possess two simple transverse ridges, as in Lophiodon, but the last in the series wants the extra back lobe. The anterior nares are very open and the orbit is incomplete behind. There are four toes on the front foot, and three behind; the radius and ulna as well as the tibia and fibia are quite separate and well developed; *T. bairdi* is peculiar in that the mesethmoid cartilage is well ossified, and the maxillaries are specially developed upwards to support it.

The *Palæotheridæ* occur in the Upper Eocene only, they were first found at Montmartre and worked out by Cuvier; since that time they have been obtained from many parts of France, the Bembridge clay, near Yarmouth, in the Isle of Wight, and in Hampshire. Several genera have been separated off, and about a dozen species, from the size of a small rhinoceros downwards. In general aspect they must have been tapir-like. The maxilla curved downwards in front as in the tapirs; the orbital and temporal fossæ were also united, and there were large anterior osseous nares; the feet were much like those of the tapir, though they were more specialised in wanting the fifth toe to the manus. The typical forty-four teeth were present; the incisors were more uniform than in the tapirs; the first pre-molar was rather rudimentary, the others formed a uniform series with the molars, which were wider than from before backwards, much pressed together, and with short crowns. They can be shown to have been developed on the type of Lophiodon, the outer wall bulging inwards, opposite the outer cusps, instead of outwards, giving the earliest indication of the lunate type of tooth; the transverse ridges were normal, and the internal cusps were slightly cut off from them, turning backwards as the rudiments of the posterior semilunes. The lower teeth presented a peculiarity here first noticed, each being formed by a double crescent, quite different from those of the tapir. The last lower molar had a third crescent behind as in Lophiodon and the Artiodactylata, but, different from the latter, in the corresponding milk tooth not presenting it. *Palaplotherium* was a smaller and earlier genus described by Owen from Hordle. In the upper jaw the first premolar was missing, and the corresponding lower one soon lost; the others were comparatively simple. The remains are very abundant, the feet were as in Palæotherium. Gervais has given the name *Propalæotherium* to a few teeth of another early form, intermediate between Lophiodon and Palæotherium. *Anchitherium* was an American form closely allied to the strictly European Palæotheridæ.

Rhinocerotidæ are at present found in Africa and South Asia only; they belong to three types, the African two-horned, non-scutellated; the Asiatic two-horned, and the Asiatic single-horned. The extinct members were numerous; four species existed in England. They did not appear before the Miocene epoch; many are found in America, but not above the Pliocene period. The existing genera have peculiarities in their incisor dentition; these teeth are quite absent in the African, and two above as well as below in the Indian species; when they are present the outer upper and the inner lower are rudimentary. The canines are absent in all; the full complement of molars are present, of similar character, and degenerating at either end; they are formed on the Lophiodon type; the outer wall is very strong and oblique, with the cusps but little developed and the cingulum large behind; the posterior transverse ridge sends forward a process from near its middle, which in one fossil species (*R. tichorhinus*) is met by another from the anterior wall to form a circular foramen behind the anterior fossa. The lower molars agree with those of Palæotherium, being formed of a double crescent, in which the posterior cornu of the front lunule is partially overlapped by the anterior cornu of the hind one; no third crescent is found on the last molar; three toes are present on all the limbs. They have not been found fossil in the Eocene strata, consequently the American species are among the earliest. Leidy has named an allied genus of small size *Hyracodon*. Its teeth resembled rhinoceros, but the anterior premolars were retained; the peculiar *uncus* on the posterior transverse ridge was wanting, and the proportions of the incisors were reversed. There are several extinct species of the genus Rhinoceros. *Acerotherium* possessed the same number of teeth as the Asiatic genera, but the nasal bones were small, slender, and smooth above, so they could scarcely have carried a horn; it is a Miocene form only; a fifth rudimentary toe was present. Except *R. pleuroceros*, which had two laterally-placed tubercles on the nasal bones, all the other species had them median. They may be divided by their incisors, as are the recent genera, some having them rudimentary, others not. All the European specimens had two horns, with or without functional incisors. The English species, which are not peculiar, are from Pliocene and Pleistocene formations; in *R. leptorhinus* the nasal septum was not ossified; in others it was much so, as in *R. tichorhinus*, a species which has been found preserved by ice in the river Vilni, a branch of the Lena, in Siberia; it possessed a hairy coat and the peculiar pit in the molars mentioned above.

From Port St. Julian, in Patagonia, Mr. Darwin first obtained bones of the peculiar genus *Macrauchenia*, which has not been found out of South America, and only in the Pleistocene deposits there. Prof. Huxley has proved the existence of a second smaller species from some fragments out of a copper mine in Bolivia. Owen showed in his, the first description of the animal, that the vertebræ were peculiar, and agreed with those of the Camels in having the vertebral artery threading a bony canal inside the spinal column, instead of through the bases of the transverse processes. It may be remarked that Myrmecophaga exhibits a similar conformation. But these vertebræ in Macrauchenia are further peculiar in having both ends of the centra quite flat instead of their being opisthocœlous, as in the allied forms. M. Bravard, who was killed in the earthquake at Mendoza, left excellent drawings of the skull and other parts of this animal, which Prof. Burmeister has since published. From them we learn that the skull was not unhorselike; the orbital ring was complete; the palate was not fully ossified between the posterior molars (the camels present the same peculiarity, though Artiodactylate); the nasal bones were extremely reduced, so that the anterior nares were directly above the posterior, and the lower jaw had the angle prolonged. Burmeister thinks, and with good reason, that the animal possessed a fair-sized trunk. There were twenty-four dorso-lumbar vertebræ, of which seventeen were dorsal. The radius and ulna, as well as the tibia and fibula, were fused throughout. The femur possessed an extremely small third trochanter; and there were three toes to each limb. The astragalus was strongly Perissodactylate, no cuboid facet being present. Our knowledge of the teeth is somewhat deficient, as they are always preserved in a much worn state. The typical forty-four were present; the incisors were equine, and the canines of the same size; the back molars were the bigger and the anterior premolars comparatively simple. The lower molars formed double crescents, as in Palæotherium.

In tracing back the descent of the *Equidæ*, the Palæotherium d'Orleans of Cuvier has been shown to be generically different, and has been called *Anchitherium*; it is also found in Nebraska. These were small horse-like animals with teeth much as in Palæotherium, forty-four in number; the first premolars were very small, and no pit was present in the incisors; the outer wall of each molar was also concave opposite the cusps; the lower molars formed double crescents, and the last possessed the extra lobe. The ulna and fibula were fused with the radius and tibia respectively; the astragalus had some of the obliqueness of that of the horse, which it resembled in many other points. But there were three toes on the limbs, the lateral ones being less strong than the median. A peculiar antorbital fossa was present.

The horse must be described before the affinities of its close allies can be realised. In it the incisors possess the well-known pit; the canines are rudimentary in the mare; the premolars resemble the molars, and the crowns are very long and deeply embedded, with a concave crescent opposite the tubercles on the outer wall and the anterior internal tubercle insulated at first; otherwise they are typical. The depressions are very deep and are filled up by cementum, to form a solid mass. The lower molars are slightly complicated double crescents. The ulna and fibula are not free. *Hipparion* had very horse-like teeth. It is a later Miocene form, and is common in the New and Old World. It possessed the antorbital pit, as in Anchitherium, but was otherwise very equine. The canines were present in both sexes of equal size, and the anterior internal tubercle of the molars was completely insulated. The median of the three digits alone was functional. *Merychippus*, a Pliocene form, recognised by Leidy from some teeth, seems to have been an intermediate form between these and Anchitherium. Fossil true horses abound in America as well as the Old World; they since became extinct in the former locality. They are found in the Pleistocene nearly everywhere; their earliest remains are from the Sevalik Hills.

With these animals the description of the fossil Perissodactylata terminates.

PERCEPTION IN THE LOWER ANIMALS

LETTERS on this interesting subject still continue to pour in upon us in so great abundance that limited space compels us to select merely the facts contained in each. The best service we can at present render to the unravelling of the, we think, yet unsolved problem is simply to accumulate facts; no doubt a satisfactory explanation will by-and-by be arrived at. First we must give place to Prof. Croom Robertson, who thus writes as to the theory broached in his former letter:—

> In my former letter I made no pretension to explain all the wonderful feats reported of dogs or other animals, but only argued, in the wake of Mr. Wallace, that it had never been sufficiently considered what help in finding their way dogs might have from smell alone. Be the help what it may in the particular cases, I thought it clear that, if in their common experience smell does not somehow supply to dogs the defect of touch, they are, as far as we can see, badly fitted out, by comparison with men, for making their way through the world. And, even after your article of last week, I must still in their interest hope that the notion of a continuous world of smells is not an impossible one.
>
> If the external world were the same to dogs that it is to men—a complex of interwoven touches and sights in space, and only in addition dogs had more frequent and varied experiences of smell, the dying away or shifting of some in a particular train of odours would doubtless, as the writer of the article urges, put a dog out

when reduced to work its way back along such a train. But my point is, that a dog will regularly think of all things, stationary or moving, by their smell, where we think of them by their touch as handled, and this upon the simple ground of fact that a dog has no hands; in which case the continuity of a road will as little to the dog as to us depend upon the standing-still of flocks of sheep or any other passing objects. It is true that our experience does not enable us easily to fancy what sort of world this of the dog's will be, but at the worst we need not conceive it, with the writer, upon the analogy of a succession of coloured mists. Do we, even with our intermittent smell, find it so impossible to refer the diffused odour of a dung-hill to a particular source? Or, to take a fair parallel case, if a sound is diffused so that it may be heard anywhere throughout a great hall, do we therefore suppose it to be everywhere and not to emerge from a definite spot? To the psychologist the strictly tactile properties of objects are themselves but sensations, which we are determined to project away from us in a certain definite order—as it happens, a very sharply defined order. With different means of projection and different sensations to project, how should the dog not have its own different world—the best it can devise out of its experiences?

Such reference to the fact of a dog's organs of sense being what they obviously are, ought not to be discounted as mere speculation, but perhaps that must be borne with. Facts of the other sort—reports, more or less authentic, of the feats of particular dogs—when made a ground for ascribing to the species preternatural powers of divination, merely because the facts are not explicable under the conditions of human experience, are beset with their own difficulty. Dogs do not always find their way back, even from the next street. Let all that side of the matter be thought of, before we suppose some unerring instinct to account for the remarkable enough feats of some that cannot be denied. Of course no train of evanescent smells can guide a dog back upon a road from which they have died away; as little, or still less, can the succession of particular smells, however constant, lead a dog right upon a line that he has never travelled over before. But that dogs, while they have no such touch as ours, do constantly use their sense of smell to guide them, cannot be doubted; and the result to them must be such a very different world of experience from ours, though developed under common laws of acquisition, that we have no means of deciding what is impossible to be done by *some* dogs through mere experience.

One of your correspondents, Mr. Brewer, had good remarks in this sense the other week. One point he raised besides upon which I would add a word. The point was whether for the dog smells would enter, instead of touches, into that fundamental experience of an external world, of which visual sensations are but marks or symbols. I should imagine that they would enter into its experience of modes of extension, by us acquired chiefly through the moving hand. But into the experience of modes of resistance, the general tactile sensibility diffused over the surface of the body would enter for the dog as well as for us.

Mr. George Henry Lewes appends to his letter on p. 401 of this week's NATURE, the following contribution to this subject:—

Gratiolet, in his work on the "Nervous System," mentions that a dog of his was always thrown into convulsions of terror by the scent of a small piece of wolf's skin, which was so old that it was worn to a shred. In my room there is a perfectly unworn wolfskin made into a rug, and on this my bulldog was accustomed luxuriously to stretch himself, without any but pleasurable emotions. Now this may have been due either to his imperfect sense of smell, or, what is more probable, to his not having inherited any terror from ancestors more likely to attack than to be afraid of a wolf.

Mr. Laughton, of the Royal Naval College, Greenwich, sends us a valuable letter, from which we extract the following:—

A passage in Sir Bartle Frere's paper on Cutch (Journal of the Royal Geographical Society, vol. xl. p. 186), seems to bear on this subject which has been interesting the readers of NATURE for some weeks past. He says:—"As elsewhere in the plain country of Sind, and here more conspicuously, owing to the absence of any prominent natural features or marked tracts, the best guides seem to depend entirely on a kind of instinct—they will generally indicate the exact bearing of a distant point which is not in sight quite as accurately as a common compass would give it to one who knew the true bearing. They affect no mysterious knowledge, but are generally quite unable to give any reason for their conclusion, which seems the result of an instinct—like that of dogs and horses and other animals—unerring, but not founded on any process of reasoning, which others can trace or follow."

I incline strongly to the solution put forward by the writer in the *Quarterly* (see letter in last number). If to this we add the consideration that dogs certainly can and do interchange ideas, and may therefore question other dogs as to the general direction in which they wish to go, the two together seem to offer a reasonable though hypothetical explanation of the very curious facts referred to.

Mr. George R. Jebb, of Shrublands, Chester, writing on March 18, says—

Last Thursday I sent my terrier dog (Tartar) by train from Chester to Shrewsbury by Great Western Railway (*i.e.* by way of Wrexham and Ruabon), I myself went by the North Western line *via* Broxton and Whitchurch; the distance by the former road is 42 miles, by the latter 38: the two railways diverge from each other for some 20 miles from Chester, and are then 16 miles apart; they afterwards converge and join at Shrewsbury. Tartar was sent from Shrewsbury to Broxton station, which is 10 miles from Chester, by the 2.55 train. I had previously arranged with the station-master to keep the dog for five or ten minutes after the departure of the train, and then to set him at liberty on the public road. The train arrived at Broxton at four o'clock. Tartar hung about the station till nearly 5.30, perhaps longer, as he was not seen starting off. He was at home at Chester at nine; he was not at all distressed. It is probable, I think, that he came back pretty direct. It is certain he came across ten miles of country, the greatest part of which he had never traversed before. It is also certain he did not return *viâ* Shrewsbury, as there was not time. He had never been at Broxton before.

Does not this experiment seem to prove that dogs—some at least—possess the wonderful power (the nature of which is at present unknown) of arriving at the knowledge of the *direction* of their home when they have been taken from it long distances by circuitous routes? And if so, is it not more probable that a dog when lost usually makes use of this power to guide himself home by the shortest practicable road, than that he finds his way back "by means of the odours he took note of" on the outward journey? How do pigeons find their way home? A railway contractor told me he has a pony which he uses chiefly for drawing a light "lorry" upon a tramway now in course of construction. There are on this tramway some loops or passing places for waggons at intervals of a mile or so. These points are dangerous if passed too quickly. The contractor drives the pony himself often at a very fast rate. The pony will on the darkest nights suddenly pull up at the dangerous points without the slightest check from the driver, who otherwise would be obliged to proceed with the greatest caution. Does the pony know his whereabouts by the sense of smell, hearing, or touch? Probably, I should say, by all three acting in unison.

The Rev. O. Fisher, of Harlton, writes:—

On a bright day when I have flowers in my window, bees frequently precipitate themselves against the window-panes, evidently desirous of reaching the plants. This is easily explained by the sense of sight; but the remarkable thing is that they do the same when the blind is drawn down, so that they cannot see the flowers, and it seems impossible that they should smell them while the window is shut. Can it be that that all-pervading æther, which brings light to our eyes, and is also believed to convey the magnetic and electric forces through media impervious to light, may act in a manner other than luminiferous towards some animals, and produce "action at a distance" upon their organs?

A Scotch correspondent, R. C., who has given us his full name and address, sends us the following interesting facts:—

A few years ago a sheep, one of a flock, belonging to Mr. Miller, flesher, Beith, Ayrshire, gave birth to three lambs; thinking that three were too heavy for the mother to suckle, he gave one to a farmer, who lived three quarters of a mile from the field where the sheep lambed. This one was taken away from the mother when barely a day old, and carried to the farmer's, where it was shut up in a close house.—

Two days after it found its way out, the door having been left open, and immediately made off for the field from which it had been taken. The writer met it near the field walking (it having chosen rightly between two branches into which the road diverges between the field and the farm-house) on the grass on the side of the road: the farmer, an old man, was in pursuit, and called upon the writer to turn it back, which he did, but not without some difficulty, as it crossed from side to side, and made efforts to pass on, with all the tactics of an old animal, while it was barely three days old, and had been barely one when it was brought from the field.—I have the following from a well-authenticated source. A farmer in Bogside, Beith, of the name of Fleming, was looking out of his window one summer's morning, about three o'clock, when he saw a fox crossing a field before it, carrying a large duck that he had captured. On coming to a stone dyke about four feet high, on the side of the field, Reynard made an effort to leap over it with his prey, but failed, and fell back into the field. After making three attempts with the same result, he sat down and viewed the dyke for a few minutes; after apparently satisfying himself, he caught the duck by the head, and standing up against the dyke with his fore paws, as high as he could reach, he placed the bill of the duck in a crevice in the wall; then springing upon the top, he reached down, and pulling up the duck dropped it upon the other side, leaped down, and picking it up, went on his way. If this is not reason, it is nearly akin to it.

We conclude with the following instances sent us by Mr. G. J. Romanes, of Cornwall Terrace, Regent's Park:—

A Colley dog accompanied his master with a flock of sheep down the Caledonian Canal, and between Oban and Greenock suffered much from sea-sickness. Several months afterwards a similar journey was undertaken by the same dog and man with another flock of sheep. Upon quitting the wharf at Oban, the dog, remembering that this was the point at which his troubles began on the former occasion, jumped ashore, leaving his master with the sheep on board the steamer. Upon landing at Greenock the man was surprised to find his dog upon the quay awaiting his arrival—the animal having run by land from one wharf to the other, over ground which he had never before traversed. The distance between Oban and Greenock is fifty miles in a straight line, but as this passes over high mountains as well as through a lake and two arms of the sea, it is not likely to have been the route taken.

My authority for this account is a leading clergyman in Glasgow, who would, no doubt, be willing to give his name to any one desiring it.

The second instance, in its bearing upon Mr. Wallace's theory, is even more conclusive. Another dog of the same kind sailed with his master from Wick to Berwick, where he was lost. Ten (?) days afterwards he appeared at his home in Sutherlandshire, footsore and exhausted, having, it must seem, run nearly the entire length of Scotland. I am indebted for this information to a medical army-officer and well-known C B. who had heard it from the owner of the dog. As my friend is at present in ill-health, I am unable to refresh my memory as to the number of days occupied by the dog's return journey, but I think it is correctly stated.

NOTES

THE meeting to which we alluded last week in connection with a memorial to the late Prof. Sedgwick, was held on Tuesday, and was attended by a large number of scientific and university friends of the late eminent geologist. Resolutions were passed that a geological museum be erected, to be called the Sedgwick Museum, and that a bust of the professor should be placed in it. A Cambridge and a London Committee were appointed. The Prince of Wales wrote that the object of the meeting would have his warm support, from the feeling of respect he entertained for the late professor.

SOME efforts are now being made gradually to give the same stimulus to the higher education of women as of men. The National Union for Improving the Education of Women has offered seven scholarships of 25*l.* each, tenable for one year, for competition throughout the United Kingdom, the competitors to be young women over sixteen years of age. The scholarships will be awarded at the local examinations held during the present year by the Universities of Oxford, Cambridge, and Edinburgh, and Trinity College, Dublin, the Science and Art Department, the Society of Arts, and the College of Preceptors.

THE examiners for the Cambridge Natural Sciences Tripos for 1872 have represented to the Board of Natural Science Studies that they are of opinion that the time has now come when an increase in the number of examiners is urgently required. The amount of physics now included in the subjects of examination is so large as to make it impossible to treat the examination in this subject any longer as an appendage to the examination in chemistry. The subjects of comparative anatomy, zoology, and physiology are also too wide to be undertaken as a general rule by one examiner. An increase in the number of examiners to seven would make it much more often possible to secure a real examination of the answers by two examiners, which is unquestionably desirable. The Board therefore recommend that in Regulation 10 for the Natural Sciences Tripos, for the words "two examiners" the words "three examiners" be substituted, and for the words "third examiner" the words "fourth examiner" be substituted, and for the words "five examiners" the words "seven examiners" be substituted. They recommend further that, in order to ensure the regular rotation of examiners, five examiners be nominated by the Board in the present year, of whom one shall be nominated to hold office for one year only.

MR. ARTHUR MILMAN, son of the late Dean of St. Paul's, has been appointed Assistant-Registrar to the University of London, in the room of Dr. Hirst.

IT is understood that Mr. Fowler, of Lincoln College, Oxford, author of the two works on Deductive and Inductive Logic, will be a candidate for the Professorship of Logic, vacant by the recent death of Prof. Wall. The appointment is made by Convocation.

THE late Mr. Julius Brenchley, whose death a month ago has been a great loss to scientific collectors, as well as to the town of Maidstone, left as the results of his voyage in the South Pacific, the last of his most extensive travels, the manuscript together with the plates which illustrate it already drawn, of a work which he fully intended to have had printed, on the natural history of those regions. It is to be hoped that some means will be taken to insure their publication.

IT is satisfactory to find that that the new "Spanish Society of Natural History" is continuing its career undisturbed by the political troubles around it. The third part of its Annals bearing date March 5, 1873, has reached this country, and is quite up to the mark of the parts which have preceded it. It contains the conclusion of Vilanova's paper on "the Pre-historic in Spain;" a catalogue, by Gundlach, of the mamifera of Cuba; a paper by Sharp, describing a new species of Spanish Coleoptera, and containing the descriptions of several new blind beetles from the caves of the mountains of the Asturias; a paper, by Colmeiro, on the elevations attained by cultivated plants in Ecuador; also a long and careful paper by Colmeiro, on the Leguminosæ of Spain and Portugal. This part completes the first volume, and contains index, and list of the members of the Society. On inspecting the latter it appears that only two of our countrymen have joined the Society. This fact has, we believe, been a considerable disappointment to the founders of the Society, who hoped it would meet with a liberal support in this country. We hope that when the existence of the Society and the merit of its publications become more widely known, it will receive the recognition it deserves.

THE brothers Godeffroy, large merchants of Hamburg, through the instrumentality of several collectors in the Pacific Islands, have accumulated a large number of specimens of marine and other animals, many of great rarity. They have lately placed their material in the hands of naturalists who interest themselves in the different departments, and their results are being published in the *Journal des Museum Godeffroy*, a quarto work, the first part of which, excellently illustrated, has just appeared.

PROF. MAX MULLER delivered his first lecture on Mr. Darwin's Philosophy of Language at the Royal Institution last Saturday; the other two will be given on Saturday next and Saturday week. From the syllabus which is before us, these lectures are likely to be of high value, and to throw much light on the subject under discussion, and in general on the place of man with reference to the lower animals. No doubt the lectures will be given to the world in a more permanent form after their delivery at the Royal Institution.

THE Rev. Mr. Moyle, lately sentenced to penal servitude, is not, as stated in the newspapers, a Fellow of the Royal Society.

THE Geologists' Association have arranged the following visits for March and April:—Thursday, March 27—Visit to the British Museum, at 3 P.M., to inspect those portions of the Botanical Collection interesting to geologists. Thursday, April 3—Visit to the Museum of the Royal College of Surgeons, at 3 P.M., to inspect the Hunterian and Zoological Collections preserved in the Museum of the College. Easter Monday and Tuesday, April 14 and 15—Excursion to Banbury, Oxfordshire, assembling at the Red Lion Hotel, Banbury at 12.30 P.M. Monday, April 21—Visit to the Museum of Practical Geology, at 8 P.M. under the guidance of Mr. Etheridge, to inspect the Palæontological Collections exhibited in the Galleries of the Museum. Saturday, April 26—Excursion to Charlton from Charing Cross by the 2.52 P.M. North Kent.

THE second annual meeting of the Glasgow Society of Field Naturalists was held on the evening of Tuesday the 18th inst., Mr. J. Allan, vice-president, in the chair. The report read by the Secretary showed that a considerable amount of work had been done during the year. Twelve excursions were held to places of interest in the neighbourhood. The papers read were numerous, varied, and interesting, and a large number of specimens were exhibited. The branches to which more particular attention was given were botany, entomology, and marine zoology.

THE largest catalogue of stars that has ever been published in America is now about to appear from the United States Naval Observatory at Washington. This work, as we learn from a recent communication of Prof. Yarnall, will embody all the valuable observations made since the foundation of the observatory, in 1842, with the meridian instruments, consisting of the work of the well-known astronomers, Coffin, Hubbard, Ferguson, Newcomb, Hall, Harkness, and Yarnall. Over fifteen years of labour have been devoted to it by Prof. Yarnall and his assistants, and he has himself made nearly one half of the observations. The catalogue will be based on over eighty thousand observations of more than ten thousand stars, many of them being quite faint, and in extreme southern latitudes, such as have never, or rarely, hitherto been observed.

BY the publication of a supplementary number, containing the proposed corrections of plates already issued, the important work of Mr. William H. Edwards upon the butterflies of North America, completes its first volume. No American work of the kind has ever been printed containing in its pages so satisfactory illustrations of the various species, new and old, as this of Mr. Edwards. The volume, as finished, embraces fifty plates, each containing several figures, representing all the varieties of each species.

AT the annual meeting of the Royal Irish Academy, held on Saturday evening, the 15th inst., the Cunningham Gold Medal was presented to Sir William Robert Wilde, Knt., M.D., in recognition of his valuable services in the compilation of the Museum catalogue, and in the arrangement of the Museum.

THE American Palestine Exploration Society has reached Syria, under the command of Lieut. Steever, United States Cavalry, accompanied by Prof. Paine, formerly of Robert College, Constantinople, and by other persons, and at last advices was fitting out at Beyrout, with a view of taking the field early in March. An arrangement has been made with the British Palestine Exploration Society by which the whole country east of the Jordan, and embracing the old territories of Moab, Gilead, and Bashan, are to be relinquished exclusively to the American society, and it is expected that, abounding as it does with ancient ruins and excavations, objects of much interest will be brought to light.

AMONG other bills lately presented to Congress is one for the establishment of a National Photographic Institute, which provides for the establishment of such an organisation in Philadelphia, where the entire theory and practice of the photographic art are to be taught by competent professors, under the direction of the National Photographic Association of the United States. The bill also provides that the sum of 30,000 dollars shall be appropriated for the purchase of a suitable building and apparatus, but that the institution shall be self-supporting, and only such fees shall be paid by the students as shall meet the actual expenses.

WE have received a couple of Salem (Massachusetts) papers, containing detailed accounts of the celebration on March 5 of the 25th anniversary of the Essex Institute of that city. This institute, mainly scientific in its aims, can trace its origin under various forms to about the middle of the last century, and under its present name was constituted by the union in 1848 of the Essex Historical and the Essex County Natural History Societies. Prof. O. C. Marsh, of Yale College, who was present, spoke of the good work which the institution has done in diffusing scientific knowledge and encouraging other societies; he also acknowledged that it was at the hands of this institution that he acquired his first taste for scientific investigation.

MR. PARTRIDGE, for many years Professor of Anatomy to the Royal Academy, died on Tuesday, 25th inst.

The following telegram from Mr. Cowie, Shanghai, dated March 25, 4^h 5^m, has been received by Mr. J. R. Hind:—"Your predicted circular black spot on sun, seen here distinctly at 9 morning, 24th." This of course refers to the possible transit over the sun's disc of an intra-Mercurial planet, and although it is very unlikely that Mr. Cowie's is a genuine find, the mere fact that he should put himself to the trouble and expense of sending such a telegram all the way from Shanghai, is an encouraging sign of the increasing and wide-spread interest taken in science.

AN International Congress is to meet in Vienna on August 4, to discuss the question of Patent Rights. The Congress, which was suggested by President Grant, will consist of scientific men, manufacturers, political economists, and skilled workmen. Each Government will be represented by a special delegate.

THE *Practical Magazine* has now reached its third number, and so far has carried out satisfactorily the promise of its prospectus; its main aim being to carry out a careful and systematic survey of the Industrial Activities of America, Germany, and France, in order to present at the earliest possible moment such information as is likely to be useful to British practical men. We believe there was a place in Britain for such a journal, and if the *Practical Magazine* continues as it has begun, we have no doubt it will satisfactorily fill this place. In get-up, paper, printing, illustrations, &c., it is one of the handsomest journals we have seen, and we hope it will have many readers both among industrial employers and employées.

TWO attempts have recently been made from Norway to reach Spitzbergen in the middle of winter, for the purpose of taking additional supplies to the storehouse at Eisfiord, erected and fitted with all necessaries last summer, as we noted some months ago, for the purpose of sheltering the exploring expeditions which are endeavouring to penetrate polewards to the north of Europe. The steamer *Albert* left Tromsoe on November 20, and reached about 77° under the meridian of Greenwich, when, on account of the great danger from the ice, not to mention the unbroken twilight, and the improbability of reaching the goal, it was determined to put back. One result of the voyage is the observation that the temperature of the sea at that season is several degrees higher than that of the air. In spite of the failure of the *Albert*, the sailing-vessel *Isbjärn* left Tromsoe on December 24, with the same object in view, and came within sight of Bear Island on January 7, which, however, it was found impossible to reach. After one or two attempts in other directions, the *Isbjärn* was compelled to put about, more from the difficulty of managing the frozen sails than from the danger from ice and the inconvenience of perpetual darkness. Notwithstanding these two failures, we learn from *Les Mondes* that M. Rosenthal, of Bremen, has fitted out his steamer *Groënland* for another attempt. M. Rosenthal has already lent his vessels to the service of science, and we hope this third attempt may be more successful than the previous ones, though it seems hopeless.

AN advanced sheet sent us of Petermann's *Mittheilungen* contains an article on King Karl Land, the island which lies to the east of Spitzbergen. English geographers identify this island with Wiche Land discovered by the Englishman Edge, in 1617, while Prof. Mohn, the writer of the article referred to, claims it for the Norwegian discoveries of 1872, and names it King Karl Land, after King Karl XV., of Norway and Sweden. Dr. Petermann maintains that Wiche Land has no existence, as the position given to it until recently in the maps was considerably south of King Karl Land, where there is nothing but water. Dr. Petermann in a note to us suggests that if the English Admiralty or any private English expedition should explore and survey it thoroughly, there might be no objection to naming it afresh. The naming of any geographical discovery is not of very great importance, but it seems to us that the discovery of the island really belongs to Edge; all that can be said against it is that either he or subsequent geographers misplaced the island by a few degrees. On the same ground the credit of many early discoveries might be taken away from those to whom it is justly attributed.

IT is said that an American aëronaut, Prof. Donaldson, intends this summer to cross the Atlantic to Ireland in a large balloon. The machine will weigh about 2,000 lb., will contain 268,000 ft. of gas, with two reservoirs to provide against leakage, and an electrical arrangement for light. The professor calculates to accomplish his trip in from 17 hours to two days and a half, and intends, if the experiment proves successful, to establish a balloon mail and passenger line round the world.

THE additions to the Zoological Society's Gardens during the past week included a short-toed eagle (*Circaëtus brachydactylus*), and two Algerian tortoises (*Testudo mauritanica*), from Morocco, presented by Capt. Perry; a white-faced tree-duck, (*Dendrocygna viduata*), and a Capoeira partridge (*Odontophorus dentatus*), from Brazil, and a crocodile from Sumatra, deposited; a Great kangaroo (*Macropus giganteus*), and a vulpine phalanger (*Phalangista vulpina*), born in the gardens; three red-breasted cardinals (*Paroaria culculata*) from South America, and a western ground parrakeet (*Geopsittacus occidentalis*) from South Australia, purchased. Only one specimen of the last mentioned extremely rare bird has been previously alive in the gardens.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 20.—"On the Temperature at which *Bacteria*, *Vibriones*, and their Supposed Germs are killed when immersed in Fluids or exposed to Heat in a Moist State." By H. Charlton Bastian, M.D., F.R.S., Professor of Pathological Anatomy in University College, London.

For more reasons than one, we may, perhaps, now look back with advantage upon the friendly controversy carried on rather more than a century ago between the learned and generous Abbé Spallanzani and our no less distinguished countryman Turberville Needham. Writing concerning his own relation to Needham, the Abbé said[*]:—"I wish to deserve his esteem whilst combating his opinion;" and, in accordance with this sentiment, we find him treating his adversary's views with great respect, and at the same time repudiating much of the empty and idle criticism in which so many of Needham's contemporaries indulged with regard to his work. This criticism Spallanzani says[†]:—"Without looking into details, contented itself by throwing doubt upon some of the facts, and by explaining after its own fashion others whose possibility it was willing to admit." He moreover warmly reprobated the ignorant and disrespectful statements made by an anonymous writer who had shown himself little worthy of being heard upon the subjects in dispute. Spallanzani on this occasion very wisely said[‡]:—"When it is a question concerning observations and experiments, it is necessary to have repeated them with much circumspection before venturing to pronounce that they are doubtful or untrustworthy. He who will allow himself to speak of them with contempt, and who can only attempt to refute them with writings composed by the glimmer derived from a treacherous lamp, will not find himself in a condition to retain the esteem of learned men." The anonymous writer (in his 'Lettres à un Americain"), to whom Spallanzani referred, had gone so far as to doubt the statements of Needham as to the constant appearance of organisms in infusions which had been previously boiled, and also intimated that even if they were to be found, it was only because they had been enabled to resist the destructive influence of the boiling fluid. This latter assertion was emphatically denied by Spallanzani—his denial being based upon a most extensive series of experiments with eggs in great variety and with seeds of all degrees of hardness. These were all found to be killed by a very short contact with boiling water. Spallanzani had thoroughly satisfied himself that even very thick-coated seeds could not resist this destructive agent, whilst he thought that the idea entertained by some, of the eggs of the lowest infusoria being protected from the injurious influence of the boiling water by reason of their extreme minuteness, was a supposition so improbable as scarcely to deserve serious consideration. Such a notion was, he thought, wholly opposed to what was known concerning the transmission of heat. Whilst, therefore, the opinion of those who believe that eggs have the power of resisting the destructive influence of boiling water could be wholly refuted, Spallanzani thought it by no means followed that the infusoria, which always after a very short time appeared in boiling infusions, had arisen independently of the existence of eggs. The infusions being freely exposed to the air, it was very possible that this air had introduced eggs into the fluids, which by their development had given birth to the infusoria.[§]

After the lapse of a century it has at last been clearly shown that this supposition of aërial contamination advanced by Spallanzani (warrantable and natural as it was at the time) is one which, in the great majority of cases, is devoid of all foundation in fact, so far as concerns the organisms essentially associated with processes of putrefaction, viz., *Bacteria* and *Vibriones*. The means of proving this statement, based upon independent observations made by Prof. Burdon Sanderson and myself, were recently submitted to the consideration of the Royal Society.[‖] Before the reading of this communication I was under the impression that almost every one of those who had taken part in controversies which had been carried on both here and abroad concerning the Origin of Life, were prepared to admit, as Spallanzani had done, that the eggs or germs of such organisms as appear in infusions were unable to survive when the infusions containing them were raised to the temperature at which water boils. This impression was produced in part by the explicit statements on the subject that had been made by very many biologists, and also in part by a comparatively recent and authoritative confirmation which this view as to the destructive effects of boiling infusions upon *Bacteria* had received. Little more than two years ago Prof. Huxley, as president of the British Association for the Advancement of Science, recorded experiments in his Inaugural Address which were obviously based upon this belief as a starting-point. And subsequently, in one of the Sectional Meetings, after referring to some of my experiments, and to the fact that all unmistakeably vital movements ceased after *Bacteria* had been boiled, Prof. Huxley added :[*]—"I cannot be certain about other persons, but I am of opinion that observers who have supposed they have found *Bacteria* surviving after boiling have made the mistake which I should have done at one time, and, in fact, have confused the Brownian movements with *true living* movements." Prof. Huxley does not now (in reference to the experiments cited in my last communication) suggest that the organisms found in the infusions were dead and had been there before the fluids were boiled : he expresses doubts concerning that which he seems formerly to have regarded as established, and, with much caution, wishes for evidence confirmatory of his own, to show that the germs of *Bacteria* and *Vibriones* are killed in a boiling infusion of hay or turnip, as they have been proved to be in "Pasteur's Solution" and in solutions containing ammonic tartrate and sodic phosphate

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[*] "Nouvelles Recherches sur les Découvertes Microscopiques et la Génération des Corps Organisés, &c. London and Paris, 1769, vol. i. p. 69.

[†] *Loc. cit.* p. 9.

[‡] *Loc. cit.* p. 114.

[§] A few pages further on this view is thus shortly expressed. :—"Il est évident que toutes les tentatives faites avec le feu, peuvent bien servir à prouver que les animaux microscopiques ne naissent point des œufs que l'on supposit exister dans les infusions avant qu'on leur fit sentir le feu: mais cela n'empéche, pas qu'ils n'aient pû être formés de ceux qui auront été portes dans les vases aprés l'ébullition."

[‖] See Proceedings of Royal Society, No. 141, 1873, p. 129.

With the view of removing this last source of doubt more effectually, and also of refuting the unwarrantable[†] conclusions of M. Pasteur, to the effect that the germs of *Bacteria* and *Vibriones* are not killed in neutral or slightly alkaline fluids at a temperature of 212° F., I almost immediately after the reading of my last communication commenced a fresh series of experiments.

Nearly two years ago, in my "Modes of Origin of Lowest Organisms," I brought forward evidence to show that *Bacteria*, *Vibriones*, and their supposed germs, are killed at a temperature of 140° F. (60° C.) in neutral or very faintly acid solutions containing ammonic tartrate and sodic phosphate, and also evidence tending to show that these living units were killed in neutral infusions of hay and in acid infusions of turnip at the same temperature.

The crucial evidence adduced concerning the degree of heat destructive to *Bacteria*, *Vibriones*, and their germs, in the saline solution was of this nature. The solution had been shown to be incapable of engendering *Bacteria* and *Vibriones* (under all ordinary conditions) after it had been boiled, although it still continued capable of supporting the life and encouraging the rapid multiplication of any of these organisms which were purposely added to it. Some of this boiled solution, therefore, was introduced into flasks previously washed with boiling water ; and when the fluids had sufficiently cooled, that of each flask was inoculated with living *Bacteria* and *Vibriones*—in the proportion of one drop of a fluid quite turbid with these organisms to one fluid ounce of the clear saline solution.[‡] These mixtures containing an abundance of living organisms were then heated to various temperatures, ranging from 122° F. (50° C) to 167° F. (75° C.), and it was invariably found that those which had been heated to 122° or 131° became quite turbid in about two days, whilst those which had been raised to 140° F. or upwards as invariably remained clear and unaltered. The turbidity in the first series having been ascertained to be due to the enormous multiplication of *Bacteria* and *Vibriones*, and it being a well-established fact that such organisms when undoubtedly living always rapidly multiply in these fluids, the conclusion seemed almost inevitable that the organisms and their germs must have been killed in the flasks which were briefly subjected to the temperature of 140° F. How else are we to account for the fact that these fluids remained quite unaltered although living organisms were added to them in the same proportion as they had been to those less-heated fluids which had so rapidly become turbid? Even if there does remain the mere possibility that the organisms and their supposed germs had not actually been killed, they were certainly so far damaged as to be unable to manifest any vital characteristics. The heat had, at all events, deprived them of their powers of growth and multiplication, and these gone, so little of what we are accustomed to call "life" could remain, that practically they might well be considered as dead. And, as I shall subsequently show, the production of this potential death by the temperature of 140° F. enables us to draw just the same conclusions from other experiments, as if such a temperature had produced a demonstrably actual death. Seeing also that these saline solutions were inoculated with a fluid in which *Bacteria* and *Vibriones* were multiplying rapidly, we had a right to infer that they were multiplying in their accustomed manner, "as much by the known method of fission, as by any unknown and assumed method of reproduction." So that, as I at the time said,[*] "These experiments seem to show, therefore, that even if *Bacteria* do multiply by means of invisible gemmules, as well as by the known process of fission, such invisible particles possess no higher power of resisting the destructive influence of heat than the parent *Bacteria* themselves possess."

This is, in fact, by far the most satisfactory kind of evidence that can be produced concerning the powers of resisting heat enjoyed by *Bacteria* and *Vibriones*, because it also meets the hypothesis as to their possible multiplication by invisible gemmules possessed of a greater power of resisting heat, and because no mere inspection by the miscroscope of dead *Bacteria* can entitle us positively to affirm that they are dead, even though all characteristically vital or "true living" movements may be absent.

Facts of a very similar nature were mentioned in the same work, strongly tending to show that *Bacteria* and *Vibriones* are also killed at the same temperature in other fluids, such as infusions of hay or turnip. These facts were referred to in the following statement[†] :—"Thus, if on the same slip, though under different covering-glasses, specimens of a hay-infusion turbid with *Bacteria* are mounted, (*a*) without being heated, (*b*) after the fluid has been raised to 122° F. for ten minutes, and (*c*) after the fluid has been heated to 140° F. for ten minutes, it will be found that in the course of a few days the *Bacteria* under *a* and *b* have notably increased in quantity, while those under *c* do not become more numerous, however long the slide is kept. Facts of the same kind are observable if a turnip-infusion containing living *Bacteria* is experimented with ; and the phenomena are in no way different if a solution of ammonic tartrate and sodic phosphate (containing *Bacteria*) be employed instead of one of these vegetable infusions. The multiplication of the *Bacteria* beneath the covering-glass, when it occurs, is soon rendered obvious even to the naked eye by the increasing cloudiness of the film."

(*To be continued.*)

Geological Society, March 12.—Joseph Prestwich, F.R.S., vice-president, in the chair. The following communications were read :—1. Note on some Brachiopoda collected by Mr. Judd from the Jurassic deposits of the East Coast of Scotland, by Thomas Davidson, F.R.S. In this note the author stated that four species of Brachiopoda collected by Mr. Judd were especially worthy of notice, two of them being quite new, and two new to Britain. Three of them were obtained from the equivalent of the Kimmeridge clay, which was the more remarkable as the Brachiopoda of that formation are comparatively few. The new species described were *Rhynchonelle Sutherlandi* and *Terebratula Joassi*, derived, with *Terebratula humeralis* Röm., from the Upper Oolite of Garty in Sutherland ; the fourth species is *Terebratula bisuffarcinata* Schlot., from the Lower Calcareous Grit of Bramberry Hill. 2. On Solfataras and deposits of Sulphur at Kalamaki, near the Isthmus of Corinth, by Prof. D. T. Ansted, F.R.S. After noticing the traces of volcanic action east of the Pindus chain, the author described the Solfataras and sulphur-deposits of the neighbourhood of Kalamaki as furnishing indications that there is even now a real though subdued volcanic energy in this part of Europe. 3. On the origin of clay-ironstone, by Mr. J. Lucas, F G.S. The author commenced by giving a general view of the varieties, chemical composition, and mode of occurrence of clay-ironstone, and suggested that the formation of all the bedded varieties may be explained by the supposition that they originated in peaty or non-peaty lagoons on the alluvial flats of the deltas of the Carboniferous formations, which would present semi-terrestrial conditions, that is to say, a surface exposed to the air but subject to be covered by floods. 4. Note in vindication of *Leptophlœum rhombicum* and *Lepidodendron gaspianum*, by Principal Dawson LL.D., F.R.S. This note accompanied some photographs of the remains of plants referred to, and was in opposition to the identification of these remains with the *Lepidodendron nothum* Unger, as proposed by Mr. Carruthers in his Appendix to Mr. Daintree's paper on the Geology of Queensland.

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[*] See Report in Quart. Journ. of Microscop. Science, Oct. 1870.

[†] Reasons for this opinion have been fully set forth in "The Beginnings of Life," p. vol. i. 374 *et seq.* ; or the discriminating reader may at once find my justification for this expression by reading pp. 58-66 of M. Pasteur's memoir in Ann de Chim. et de Physique, 1862.

[‡] Fuller details concerning these experiments may be found in the little work already mentioned at pp. 51-56, and also in "The Beginnings of Life," vol. i., pp 325-332.

[*] "Modes of Origin of Lowest Organisms," 1871, p. 60.

[†] *Loc. cit.* p. 60.

Zoological Society, March 18, 1873.—The Viscount Walden, F.R.S., president, in the chair.—A communication was read from Mr. R. B. Watson on some marine mollusca from Madeira, including a new genus of the *Muricidæ*, proposed to be called *Chascax* and a new *Rissoina*, and embracing descriptions of the whole of the *Rissoæ* of the group of islands.—A communication was read from Dr. J. D. Macdonald, F.R.S., on a specimen of *Acanthias vulgaris* and a species of *Galeus*, probably new to science, taken off Flinder's Island, Bass Straits.—Mr. W. T. Blandford read a paper on the Gazelles of India and Persia. This contained the description of a new species, *Gazella fuscifrons*, founded on a single specimen obtained by the author in 1872, near the edge of the desert of Seistan.—A communication was read from Dr. J. S. Bowerbank, F.R.S., containing the fifth part of a series of memoirs entitled Contributions to a General History of the Spongiadæ.—A communication was read from Mr. Gerard Krefft, C.M.Z.S., containing the description of a new species of crocodile from Queensland, proposed to be called *Crocodilus johnsoni*.—Mr. Edward Bartlett exhibited and gave the description of a new moth belonging to the family Saturniidæ, which had been obtained in the interior of Madagascar by Mr. T. Waters, and which was proposed to be called *Tropæa madagascariensis*.

Mathematical Society, March 13.—Dr. Hirst, F.R.S., president, in the chair.—Prof. Greenhill, of Cooper's Hill College, was elected a member.—Mr. R. B. Hayward read a paper on an extension of the term *area* to any closed circuit in space. In the sense in which the writer employed the term, area is no longer a mere magnitude or a magnitude affected only with the positive or negative sign, but a magnitude affected with direction; in other words it is a *vector*, not simply a *scalar*. The paper concluded with a few illustrations of the use of this extension of the term area.—Other communications were, on the evaluation of a class of definite integrals involving circular functions in the numerator and powers of the variable only in the denominator, by Mr. J. W. L. Glaisher; note on normals and the surface of centres of an algebraical surface, by Mr. S. Roberts, V.P.; and a proof of the proposition that a number which divides the product of two numbers and is prime to one of them will divide the other, by Mr. M. Jenkins (Hon. Sec.).—Notice was taken in NATURE (August 1, 1872) of the formation of a mathematical society in Paris on the plan of the similar societies of London, Moscow and Berlin. This society having forwarded the first number of its "Bulletin," it was agreed to exchange publications.

Chemical Society, March 20, Dr. Frankland, F.R.S., president, in the chair.—Mr. C. W. Siemens, F.R.S., delivered a lecture "On Iron and Steel." The lecturer, after adverting to his former discourse delivered before the Society in 1868, and describing the various experiments he had made to obtain malleable iron direct from the ore, gave an account of the process by which he had succeeded in completely attaining that object. It consists essentially in fusing the ore by means of the most intense heat in a revolving furnace, and then adding the requisite amount of carbonaceous matter to reduce the iron to the metallic state. The malleable iron thus precipitated in the molten mass becomes aggregated into balls by the revolution of the furnace, and can then be easily removed. It is free from sulphur, phosphorus, and other impurities, and dissolves readily in a bath of molten cast iron, producing steel of a quality equal to that made from the best Swedish bar iron.

Anthropological Institute, March 18.—Prof. Busk, F.R.S., president, in the chair. A paper was read by Mr. George Harris, F.S.A., on theories regarding intellect and instinct, with an attempt to deduce a satisfactory conclusion therefrom. The author, after taking a general survey of the opinions on this subject, citing those of Aristotle, Plato, Descartes, Hobbes, Locke, and several other writers, including some modern authorities, proceeded to compare them one with another, and to consider how far certain apparently irreconcileable differences might be considered compatible. The great perfection of the sensitive system in animals he considered to be the main cause of the unerring dexterity with which they engage in various operations connected with their career. And although they differ essentially from man as regards his capacity for abstract studies, it appears difficult to deny to them the possession of an immaterial being of some kind. High authorities, both among philosophers and divines, have attributed to them a future state of existence. Mr. Harris also read a paper on the concurrent contemporaneous progress of renovation and waste in animated frames, and the extent to which such operations are controllable by artificial means. The writer took a general view of the opinions of those who have treated on this subject, more especially the older authorities, citing Galen, Willis, Buffon, Hunter, and Smellie, and referring also to recent articles on the subject in *Fraser's Magazine* and the *Edinburgh Review*. He adverted to the ascertained fact of the progress of renovation and waste in all animated frames, as also to the circumstance that certain of these operations were known to be controllable. He analysed the principle of waste and decay in different bodies, and referred to ossification of the bones and deterioration of the blood as contributing to those conditions. As medical science advances these matters might be more perfectly understood. He recommended experiments of various kinds as to the nature of substances, and their effect on bodies animate as well as inanimate, and with regard to animals and plants as well as man.

Royal Horticultural Society, March 19.—Scientific Committee, Dr. J. D. Hooker, C.B., in the chair. Prof. Thiselton Dyer called attention to the discovery by Fankhauser of the prothallial stage of *Lycopodium*. It appears to be almost identical with that of the *Ophioglosseæ*, and consequently altogether different from that of *Selaginella*. It was remarkable that the carboniferous *Lepidostrobus* and *Triplosporites* differed as regards their spores in precisely the same way as *Lycopodium* and *Selaginella*. If the nature of the germination in the two latter must be held to imply systematic diversity, analogy would equally imply it in the case of the two former. But the parallelism would, under these circumstances, be extremely difficult to understand.—General Meeting, W. Wilson Saunders, F.R.S., in the chair. The Rev. M. J. Berkeley commented on the fine collection of *Cycadeaceæ* exhibited by Mr. Bull, a well-fruited pot plant of the Loquat (*Eriobotrya japonica*), and *Epidendrum erubescens*—a Guatemalan orchid rarely seen in flower, which was exhibited by Mr. C. Leach.

Entomological Society, March 17.—Prof. Westwood, president, in the chair.—M. Ernest Olivier was balloted for and elected a foreign member.—The president exhibited a very rare species of *Paussus* from Abyssinia.—Mr. Smith exhibited a box of ants sent from Calcutta by Mr. G. A. J. Rothney, collected principally in the Botanic Gardens. There were many new species amongst them, a complete series of which was to be reserved for the national collection.—Mr. Cole exhibited two boxes of *Bombycidæ* from Natal.—Mr. Bates read a paper on some species of geodephagous coleoptera from China.—Mr. Müller made some remarks on a beetle (*Aræocerus coffeæ*) which had been imported into Basle with some coffee from Java, and that the insect had since become naturalised and might be found in any quantity there. Mr. Müller also remarked on a cargo of ground nuts which arrived in London direct from Sierra Leone, the kernels of which were destroyed by myriads of the larvæ and perfect insects of the *Tribolium ferrugineum*, accompanied by the larvæ and perfect insects of a species of *Rhizophagus* preying on the former.—Mr. Dunning read some further notes on *Atropos pulsatoria*, with reference to Dr. Hagen and Mr. W. A. Lewis. Mr. Bates put some questions to the meeting, suggested to him by Mr. Darwin, with a view to eliciting information as to sexual differences in certain insects, viz., whether any cases had been noticed of sexual differences in the ocellated spots with which certain insects, as the *Bombycidæ*, were furnished, and also as to sexual differences amongst the *Buprestidæ*. A conversation ensued during which Mr. Jenner Weir stated that *Satyrus hyperanthus* had more ocellated spots in the female than in the male; and Mr. Butler mentioned that *Drusillus* had double ocelli in one sex. It was also stated that Mr. Saunders had detected sexual differences among the *Buprestidæ*.

MANCHESTER

Literary and Philosophical Society, March 4.—Dr. J. P. Joule in the chair.—Mr. Baxendell read the following communication from Mr. S. Broughton:—It appears there is some doubt as to the existence of ball discharge in thunderstorms. At the request of Mr. Baxendell I communicate an observation of such, seen during the approach of a storm, in 1854 or 1855, when walking from Altrincham to Timperley. Over the edge of a cloud near the east horizon a flash of lightning was seen, and a ball *apparently* the size of one from a Roman candle shot upwards through an arc of 20° or 30°. I cannot say that it went to another cloud, but that would most likely be so, as my attention was taken up watching the progress of the electric ball.—E. W. Binney, V.P., F.R.S., said that shortly after the meeting of the Society on January 21, when he exhibited the singular fossil plants, which were quite new to him at the time, which he thought would have to be placed in a new genus, he had received excellent transverse and longitudinal sections of similar specimens from Professor Renault of Cluny, which were if possible in a more beautiful state of preservation than those found in the carboniferous strata of Lancashire. On February 4, Prof. W. C. Williamson, F.R.S., stated that these specimens were the branches or stems of the well-known genus *Asterophyllites*. Now the French professor states that he had described this fossil plant in a memoir read before the Academy in 1870, and that in his opinion it belonged to *Sphenophyllum*. I am not in possession of the facts from which the two learned professors came to such different conclusions, but I am inclined to consider the singular little stem as belonging to a new genus until the leaves of *Sphenophyllum* or *Asterophyllites* are found attached to it. When this comes to pass of course there can be no doubt on the matter.—The President said that he had made another observation of the position of the freezing point in the thermometer used in making the observations recorded in the Proceedings for April 16, 1867, and February 22, 1870. The gradual rise of the zero during twenty-nine years was shown by a diagram, the ordinates representing divisions etched on the glass stem, each corresponding to $\frac{1}{12\cdot5}$ of a degree Fahrenheit.—Mr. William H. Johnson, B.Sc., read a paper "On the Influence of Acids on Iron and Steel," in which he showed the general effects of acid; its effects on the weight; on the breaking strain and elongation; effect of pyroligneous acid; effects of acids on copper and brass; and of zinc on iron.

PARIS

Academy of Sciences, March 17, M. de Quatrefages, president, in the chair.—The following papers were read: On the theory of the movement of Jupiter, by M. Le Verrier.—The transit of Venus—method for obtaining the moment of contact by photography, by M. Janssen. The author suggests the use of a photographic plate cut in the form of a disc, and made to revolve. By this means a number of photographs can be obtained with very minute intervals of time between each exposure.—On the heat produced by the mixture of the hydracids with water and on the molecular volumes of their solutions, by M. Berthelot. The acids experimented on were the hydrochloric, hydrobromic, and hydriodic. The author decides that these acids and their compounds give rise to similar amounts of molecular work.—On new applications of the principles of the navigation sluice to oscillating columns of liquid, by M. A. de Caligny.—On a shock of earthquake observed at Florence on March 12, 1873, by M. de Tchihatchef. The shock was observed at 9h. 5m. p.m., it did not last more than half a second, and its direction was S.E. to N.W., bar. 725mm.—M. Secchi presented his memoir "On the Distribution of the Prominences on the Solar Disc, and on the study of the Spots."—On barometic changes and their connection with magnetic variations, by M. J. A. Broun.—New experiments on singing flames, by M. F. Kastner.—Observations on the theory of solar cyclones, by M. E. Vicaire. The author raised several objections to M. Faye's theory of the sun, and promised to explain his own hypothesis shortly; this, he said, was simply that of Wilson.—On "Spectrometry;" Spectronatrometry, by MM. P. Champion, H. Pellet, and M. Grenier. The authors described an instrument for the spectroscopic estimation of minute quantities of sodium. The principle depended on the comparison of a sodium flame in which a known quantity of sodium was being heated with the flame coloured by the substance the sodium in which it was required to know. The apparatus described was somewhat complicated, but the principle upon which it worked was the use of a graduated compensating wedge of coloured glass. M. Janssen made some observations on the process.—Observations on M. Gernez's recent note on the crystallisation of supersaturated solutions, by M. Ch. Violette.—On the methods of increasing the length of bones and stopping their growth, by M. Ollier. On the anatomy of *Comatula rosacea*, by M. Edm. Perrier. On a deposit of fossil mammiferæ near Lapsista, Macedon, by M. Gorceix. "On polyhedric concamerations," by M. G. Perry.

DIARY

THURSDAY, MARCH 27.

ROYAL SOCIETY, at 8.30.—The Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and of its Variation in Amount with her Phases (Backerian Lecture): Earl of Rosse.

SOCIETY OF ANTIQUARIES, at 8.30.—Election of Fellows.

ROYAL INSTITUTION, at 3.—Coal and its Products: A. V. Harcourt.

FRIDAY, MARCH 28.

ROYAL INSTITUTION, at 9.—Force and Energy: Prof. Clifford.

QUEKETT CLUB, at 8.

ROYAL COLLEGE OF SURGEONS, at 4.—Extinct Mammals: Prof. Flower.

SATURDAY, MARCH 29.

ROYAL INSTITUTION, at 3.—Darwin's Philosophy of Language: Prof. Max Müller.

MONDAY, MARCH 31.

LONDON INSTITUTION, at 4.—Fungoid Organisms: Prof. Thiselton Dyer.

TUESDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Forces and Motions of the Body: Prof. Rutherford.

ANTHROPOLOGICAL SOCIETY, at 8.—Notes on the Collection of Peruvian Skulls and Pottery lately received from Consul Hutchinson: Prof. Busk and Dr. Barnard Davis.—On the Natives of Vancouver's Island: Richard King.—On a Human Skull from Birkdale, Southport: T. M. Reade.

SOCIETY OF BIBLICAL ARCHÆOLOGY, at 8.30.

ZOOLOGICAL SOCIETY, at 8.30.—On the Brain and a portion of the nervous system of *Pediculus capitis*: Dr. J. S. Bowerbank.—Notes on the genera of Turtles (*Oiacopodes*) and especially on their skeleton and skulls: Dr. J. E. Gray.—Descriptions of three new species of Flying Squirrels: Dr. A. Günther.

ASIATIC SOCIETY, at 3.

WEDNESDAY, APRIL 2.

SOCIETY OF ARTS, at 8.—On Economy of Fuel for domestic purposes: Capt. Douglas Galton, C.B.

LONDON INSTITUTION, at 7.—Courts of Special Commercial Jurisdiction: N. H. Paterson.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On a new *Callidina* with the result of experiments on the desiccation of Rotifers: H. Davis.—On the Development of the Sturgeon's facial arches: W. K. Parker.

THURSDAY, APRIL 3.

CHEMICAL SOCIETY, at 8.—A way of exactly determining the specific gravity of Liquids; Dr. H. Sprengel.—On Cymene from various sources: Dr. C. R. A. Wright.—Researches on the action of the Copper-zinc couple on organic bodies, II.—On the iodides of Amyl and Methyl: J. H. Gladstone and A. Tribe.—Contributions from the Laboratory of the London Institution, No. XI.—Action of the acid chlorides on Nitrates and Nitrites: Dr. H. G. Armstrong.

LINNEAN SOCIETY, at 8.—On new Indian Fishes: Surgeon-Major F. Day.—On the Fungi of Ceylon: Rev. M. J. Berkeley and C. E. Broome.

ROYAL INSTITUTION, at 3.—Coal and its Products: A. V. Harcourt.

BOOKS RECEIVED

ENGLISH.—Celestial Objects for Common Telescope. 3rd edit.: Rev. T. W. Webb (Longmans).—Elementary Treatise on Wave Theory of Light. 3rd edit.: H. Lloyd (Longmans).—The Childhood of the World: E. Clodd (Macmillan).

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THURSDAY, APRIL 3, 1873

ORIGIN OF CERTAIN INSTINCTS

THE writer of the interesting article in NATURE of March 20 doubts whether my belief "that many of the most wonderful instincts have been acquired, independently of habit, through the preservation of useful variations of pre-existing instincts," means more than "that in a great many instances we cannot conceive how the instincts originated." This in one sense is perfectly true, but what I wished to bring prominently forward was simply that in certain cases instincts had not been acquired through the experience of their utility, with continued practice during successive generations. I had in my mind the case of neuter insects, which never leave offspring to inherit the teachings of experience, and which are themselves the offspring of parents which possess quite different instincts. The Hive-bee is the best known instance, as neither the queen nor the drones construct cells, secrete wax, collect honey, &c. If this had been the sole case, it might have been maintained that the queens, like the fertile females of humble-bees, had in former ages worked like the present neuters, and had thus gradually acquired these instincts; and that they had ever afterwards transmitted them to their sterile offspring, though they themselves no longer practised such instincts. But there are several species of Hive-bees (*Apis*) of which the sterile workers have somewhat different habits and instincts, as shown by their combs. There are also many species of ants, the fertile females of which are believed not themselves to work, but to be served by the neuters, which capture and drag them to their nests; and the instincts of the neuters in the different species of the same genus are often different. All who believe in the principle of evolution will admit that with social insects the closely allied species of the same genus are descended from a single parent-form; and yet the sterile workers of the several species have somehow acquired different instincts. This case appeared to me so remarkable that I discussed it at some length in my "Origin of Species;" but I do not expect that anyone who has less faith in natural selection than I have, will admit the explanation there given. Although he may explain in some other way, or leave unexplained, the development of the wondrous instincts possessed by the various sterile workers, he will, I think, be compelled to admit that they cannot have been acquired by the experience of one generation having been transmitted to a succeeding one. I should indeed be glad if anyone could show that there was some fallacy in this reasoning. It may be added that the possession of highly complex instincts, though not derived through conscious experience, does not at all preclude insects bringing into play their individual sagacity in modifying their work under new or peculiar circumstances; but such sagacity, as far as inheritance is concerned, as well as their instincts, can be modified or injured only by advantage being taken of variation in the minute brain of their parents, probably of their mothers.

The acquirement or development of certain reflex actions, in which muscles that cannot be influenced by the will are acted on, is a somewhat analogous case to that of the above class of instincts, as I have shown in my recently published book on Expression; for consciousness, on which the sense of utility depends, cannot have come into play in the case of actions effected by involuntary muscles. The beautifully adapted movements of the iris, when the retina is stimulated by too much or too little light, is a case in point.

The writer of the article in referring to my words "the preservation of useful variations of pre-existing instincts" adds "the question is, whence these variations?" Nothing is more to be desired in natural history than that some one should be able to answer such a query. But as far as our present subject is concerned, the writer probably will admit that a multitude of variations have arisen, for instance in colour and in the character of the hair, feathers, horns, &c., which are quite independent of habit and of use in previous generations. It seems far from wonderful, considering the complex conditions to which the whole organisation is exposed during the successive stages of its development from the germ, that every part should be liable to occasional modifications: the wonder indeed is that any two individuals of the same species are at all closely alike. If this be admitted, why should not the brain, as well as all other parts of the body, sometimes vary in a slight degree, independently of useful experience and habit? Those physiologists, and there are many, who believe that a new mental characteristic cannot be transmitted to the child except through some modification of that material sub-stratum which proceeds from the parents, and from which the brain of the child is ultimately developed, will not doubt that any cause which affects its development may, and often will, modify the transmitted mental characters. With species in a state of nature such modifications or variations would commonly lead to the partial or complete loss of an instinct, or to its perversion; and the individual would suffer. But if under the then existing conditions any such mental variation was serviceable, it would be preserved and fixed, and would ultimately become common to all the members of the species.

The writer of the article also takes up the case of the tumbling of the pigeon, which habit, if seen in a wild bird, would certainly have been called instinctive; more especially if, as has been asserted, it aids these birds in escaping from hawks. He suggests that it "is a fancy instinct, an outlet for the overflowing activity of a creature whose wants are all provided for without any exertion on its part;" but even on this supposition there must have been some physical cause which induced the first tumbler to spend its overflowing activity in a manner unlike that of any other bird in the world. The behaviour of the ground-tumbler or Lotan of India, renders it highly probable that in this sub-breed the tumbling is due to some affection of the brain, which has been transmitted from before the year 1600 to the present day. It is necessary gently to shake these birds, or in the case of the Kalmi Lotan, to touch them on the neck with a wand, in order to make them begin rolling over backwards on the ground. This they continue to do with extraordinary rapidity, until they are utterly exhausted, or even, as some say, until they die, unless they are taken up, held in the hands, and soothed; and then they recover. It is well-known that certain lesions of the brain, or internal parasites, cause animals to turn incessantly round and round, either to the right or left, sometimes accompanied by a backward movement: and I have just read, through the kindness of Dr. Brunton, the account given by Mr. W. J. Moore (*Indian Medical Gazette*, Jan. and Feb 1873) of the somewhat analogous result which followed from pricking the base of the brain of a pigeon with a needle. Birds thus treated roll over backwards in convulsions, in exactly the same manner as do the ground-tumblers; and the same effect is produced by giving them hydrocyanic acid with strychnine. One pigeon which had its brain thus pricked recovered perfectly, but continued ever afterwards to perform summersaults like a tumbler, though not belonging to any tumbling breed. The movement appears to be of the nature of a recurrent spasm or convulsion which throws the bird backwards, as in tetanus; it then recovers its balance, and is again thrown backwards. Whether this tendency originated from some accidental injury, or, as seems more probable, from some morbid affection of the brain, cannot be told; but at the present time the affection can hardly be called morbid in the case of common tumblers, as these birds are perfectly healthy and seem to enjoy performing their feats, or, as an old writer expresses it, "showing like footballs in the air." The habit apparently can be controlled to a certain extent by the will. But what more particularly concerns us is that it is strictly inherited. Young birds reared in an aviary which have never seen a pigeon tumble, take to it when first let free. The habit also varies much in degree in different individuals and in different sub-breeds; and it can be greatly augmented by continued selection, as seen in the house-tumblers, which can hardly rise more than a foot or two above the ground without going head over heels in the air. Fuller details on tumbler-pigeons, may be found in my "Variation of Animals under Domestication," vol. i. pp. 150, 209.

In conclusion, from the case of neuter insects, of certain reflex actions, and of movements such as those of the tumbler-pigeon, it seems to me in the highest degree probable that many instincts have originated from modifications or variations in the brain, which we in our ignorance most improperly call spontaneous or accidental; such variations having led, independently of experience and of habit, to changes in pre-existing instincts, or to quite new instincts, and these proving of service to the species, have been preserved and fixed, being, however, often strengthened or improved by subsequent habit.

With regard to the question of the means by which animals find their way home from a long distance, a striking account, in relation to man, will be found in the English translation of the Expedition to North Siberia, by Von Wrangell. He there describes the wonderful manner in which the natives kept a true course towards a particular spot, whilst passing for a long distance through hummocky ice, with incessant changes of direction, and with no guide in the heavens or on the frozen sea. He states (but I quote only from memory of many years standing) that he, an experienced surveyor, and using a compass, failed to do that which these savages easily effected. Yet no one will suppose that they possessed any special sense which is quite absent in us. We must bear in mind that neither a compass, nor the north star, nor any other such sign, suffices to guide a man to a particular spot through an intricate country, or through hummocky ice, when many deviations from a straight course are inevitable, unless the deviations are allowed for, or a sort of "dead reckoning" is kept. All men are able to do this in a greater or less degree, and the natives of Siberia apparently to a wonderful extent, though probably in an unconscious manner. This is effected chiefly, no doubt, by eyesight, but partly, perhaps, by the sense of muscular movement, in the same manner as a man with his eyes blinded can proceed (and some men much better than others) for a short distance in a nearly straight line, or turn at right angles, or back again. The manner in which the sense of direction is sometimes suddenly disarranged in very old and feeble persons, and the feeling of strong distress which, as I know, has been experienced by persons when they have suddenly found out that they have been proceeding in a wholly unexpected and wrong direction, leads to the suspicion that some part of the brain is specialised for the function of direction. Whether animals may not possess the faculty of keeping a dead reckoning of their course in a much more perfect degree than can man; or whether this faculty may not come into play on the commencement of a journey when an animal is shut up in a basket, I will not attempt to discuss, as I have not sufficient data.

I am tempted to add one other case, but here again I am forced to quote from memory, as I have not my books at hand. Audubon kept a pinioned wild goose in confinement, and when the period of migration arrived, it became extremely restless, like all other migratory birds under similar circumstances; and at last it escaped. The poor creature then immediately began its long journey on foot, but its sense of direction seemed to have been perverted, for instead of travelling due southward, it proceeded in exactly the wrong direction, due northward.

CHARLES DARWIN

UNIVERSITY OARS

II.

WE resume our remarks at the point at which we left off last week, *i.e.* the uncomfortable one of the killed and wounded in the great annual battles on the Thames.

Of the 294 men who rowed in the 26 races taking place between the years 1829 and 1869 (both inclusive), 39 men have died, or rather we should say 40, for one other death has occurred, apparently since the introductory portion of the work was written, and the tables in the appendix were compiled, and we are assured on the authority of elaborate statistics and the logic of averages, that, in comparison with other portions of the civil community, this is a very moderate death-rate. Of the diseases which have carried off in youth or early manhood these 40 men, we will only instance one kind, as being the only one with which boat-racing can presumably be connected, namely consumption, "and other diseases of the chest:" to these perhaps may be added "heart affections." Of the former there are 9, of the latter 3, in all 12.

We are assured, again, that this percentage is a moderate one, that these ailments are still more exacting, not only with other portions of the "civil community," but also with the seamen of the Royal Navy, and with the men who fill the ranks of the army, and notably so of the Guards; it being notorious that men of tall stature are more liable to be attacked by, and less able to resist, diseases of this nature than men of more compact build. But here we must confess that this portion of the book does not leave upon our minds quite so comfortable an impression as we could desire. It is felt throughout that the parties compared have little in common in the essentials that make such comparisons valuable. True the University Oars as a rule are tall, above the average height even of men in their own rank of life; but they are "picked" men—picked for strength as well as stature—picked for physical power already proved—whose whole life from infancy up to manhood has been one varied series of all that art, nature, and science could bring to bear favourably upon their growth and development. While on the other side do we not find the reverse of these conditions prevailing? does not the author himself, elsewhere, describe with painful emphasis the wretched forms, stunted frames, unhealthy occupations and debasing habits of a large portion of the "civil community;" and is it not notorious that soldiers in regiments where height of stature is the chief requisite, were probably throughout their growing time subject to privations in food and clothing and housing, which coupled with rapid growth, and their surroundings after enlistment, presented the very conditions most favourable to the development of the diseases in question?

While expressing an opinion of qualified satisfaction with the comparisons instituted, we can in no way question the accuracy of the figures given; but we must record our feeling, which we believe will be one generally felt, that such evidence fails in accomplishing the purpose for which it was advanced.

We have stated our belief that, could the truth be ascertained, as many or more injuries would be found to have occurred in the same space of time (a similar number of men having been so engaged) in hunting, at foot-ball, or at cricket; probably too as many of these injuries would have proved fatal. But in stating this we are brought face to face with the fact that, in all instances of hurt or of injury so sustained, they would arise from *accidents*. But this is not the case with the injuries which spring from Boat-racing; here, be they trifling or be they severe, be they few or be they many, they seem to be the natural outcome of the exercise itself; not a hurt, in a sense in which we commonly use that word, of bruise, or break, or strain, and to which we may apply support or remedy, but an unknown evil, unfelt, unsuspected, at the time, but to which existence has been given—to be developed in after-life, when we least suspect it, and are least able to cope with its advances. Now the question which presents itself here to us, and must present itself to any one who cares for the continuation of this favourite exercise and yet would free it from this grave drawback—is this: Are these injuries, these evils inevitable? Yes, we answer, at once, and without reservation or qualification, to two points of misconception only is hurt or injury in these contests to be attributed: correct these and this exercise will stand out at once, relieved from all let or hindrance, free, freer than any other, because it is exempted from the *accidents* that lie in the path of others. Correct these, and the tripartite list which Dr. Morgan has supplied of *benefited*, *uninjured*, and *injured*, would be transformed into one uniform list of the first-mentioned only, for every one would be benefited who pursued this pastime.

In the contest which took place on the Thames last week the points which would probably strike an ordinary spectator most forcibly would be these:—first, the length of the course (four and a quarter miles), and second, the shortness of the time in which the boats covered the distance (not quite 20 minutes), and he would probably think that the first was too long, and if he did not actually think that the second was too short (for who admits that a race can be run or rowed too quickly?), he would marvel all the same at its performance, and wonder how men *could* propel a boat over such a long course in such a short space of time. Whether the course could be shortened with advantage, and yet sufficiently test the crews, we will not here discuss, although we think it is open to discussion; and how it is possible to propel a boat over it in the above-mentioned time, is only to be explained by one means, *i.e.*, by a critical examination of the boat itself, and, let us add, a glance at its crew. In the latter he will see eight as fine young men as he probably ever saw in his life before; in the former he will see a machine bearing no resemblance to anything he ever saw afloat, either on river, lake, or sea, or possessing in shape, or size, or bulk, or weight, any of the proportions which other boats possess: so slim for its length, so straight, so sharp! constructed at all points to cleave the water like a knife-blade! fitted out at all points to save every fraction of weight in rowing or steering gear, to utilise and concentrate every ounce of propelling power exerted by the oarsmen from stroke to bow.

Now although the perception of this may to some extent explain the extraordinary rapidity of the race, it will not remove from the spectator's mind the idea of its severity. To him it will still appear that the work will have been tremendous, and he is right: the work *was* tremendous, though not perhaps in the manner or of the kind which he imagines, or of what is commonly understood when the word *work* is used.

"In rowing, as in some other exercises, where the voluntary muscles of the trunk and of the upper limbs are engaged, the breath is "held" in the lungs during the muscular effort, in order to keep the chest distended, or firm, or as it is technically called, "fixed," that these muscles may have firm and unyielding points of attachment during the contractile efforts—fixed fulcra for their levers; and when this is prolonged or repeated over any considerable space of time, it becomes a highly disturbing influence to respiration, and doubly so if the exercise be one which greatly augments the respiratory requirement; for the act of fixing the chest is accomplished by retaining the chest at its point of expansion, when in the natural order of respiration it would be collapsing. And while in ordinary effortless breathing, or in exercises where the lower limbs are solely or chiefly employed, such as walking or running, the inspiration and expiration follow each other in uninterrupted succession, each occupying about the same space of time as the other, and the two constituting the entire process—in rowing, both these acts are hurried over during that time in which the muscles are relaxed, *i.e.*, towards the close of the stroke, and on the rapid forward dart of the body preparatory to another; when the breath is again held and the chest fixed during the muscular effort. Now in ordinary breathing the rate is, to a full-statured man, from 16 to 20 inspirations per minute, while the racing pace is 40 per minute, or more, and we have seen that the breathing is regulated by the stroke, a breath for each, and these are at 40 a minute! But we have also seen that although there is a breath for every stroke, still the double process of inspiration and expiration does not occupy the whole of even this brief space of time, being accomplished during the momentary muscular relaxation towards the end of the stroke and the forward reach of the body preparatory to another, greatly augmenting the rate at which this double process is performed." Truly the spectator was right in thinking a boat-race to be tremendous work, for so it is, as regards heart and lungs, at any rate.

And now with reference to the second aspect of boat-racing, its demands upon the muscular energies of the body, the aspect which probably the spectator had in view when impressed by the probable amount of "work" of the race. Now will he be relieved or will he be disappointed to learn that the work to be done, the muscular exertion to be undergone, is very slight indeed,—certainly not more than, if so much as, was undergone by any one of the thousands who ran the distance shouting on the banks. Perhaps his examination of the boat and boating gear has prepared him for some such revelation, perhaps it has not, but we can assure him that its accuracy has been proved, not only by our own long personal observations of its mode of action and consequent results upon the frames of the men themselves, but by practical and theoretic tests of the most searching kind, instituted by men of unquestionable ability for the office, and of unquestionable freedom from prejudice or bias.

We have doubted whether this would be a relief or a disappointment to the ordinary spectator; nor have our doubts been restricted to him. Others whose practical knowledge of the art and exercise of rowing is great have also found it embarrassing how to receive this announcement. For ourselves, we regard it as an evil, although not one without a remedy. But not only is the muscular effort altogether disproportionate to that of the organs of circulation and respiration, but inadequate in its amount to develop and sustain to their full capacity the frames of the men engaged therein, when rowing is practised for exclusive exercise: it is found that this muscular exertion, inadequate as it is, is also very irregularly and partially divided, very unequally distributed among the several portions of the body. Thus, we quote again from our former source:—

> "A little examination will prove, I think, what at first may not have been surmised, that the legs have the largest share of the work in rowing, for while all other parts employed, back, loins, and arms, act somewhat in detail and in succession, the legs act continuously throughout the stroke, and the individual efforts of each, and the concentrated efforts of all the other parts of the body employed are transmitted through them to the point of resistance—the stretcher. . . . . It will be found also that the stroke is nearly finished before the contractile efforts of the arms are in any degree engaged, namely, when the trunk reaches the vertical line, and they are called in to finish the stroke, and to turn and run out the oar on the forward reach of the body preparatory to another. Rowing thus gives employment to a large portion of the back, more to the loins and hips, and most of all to the legs; but it gives little to the arms, and that chiefly to the fore-arm, and least of all to the chest."

At this point Dr. Morgan's views and our own do not run quite parallel, but the divergence is not so great as at first sight may appear, and almost seems the expression of the impatience of the Oarsman at anything which might be construed as a hint that rowing had a fault or a defect of any kind whatever, than the decision of the Physician on a question which he had considered. It may be a loss sometimes, perhaps, to have more qualifications than one for judging or writing on a given subject. Thus we recognise the physician when he admits the importance of the development of the chest by muscular exertion, admits that in so doing we do not merely increase its muscular coverings, but actually expand the walls of the thoracic cavity, giving ample space for the organs contained therein to perform their all-important functions, nay, that these organs themselves are endowed with increased bulk, vigour, and power by the same means: but here the oarsman crops up, and he contends that all these good things are to be obtained by practice at the oar, for that rowing *does* give this invaluable muscular exertion to the chest. Again, we recognise the physician, acknowledging the substantiated facts of physiological inquiry when he admits that the chest receives its muscular action through the arms; but again the oarsman contends that in rowing the arms *do* have energetic work to perform adequate to this task; nay, that in his own experience, when captain of his college boat, "he has seen the biceps expand and the forearm increase in girth;" the latter probably, but the former—well, they must have rowed in very bad style to cause this development! But scarcely is this avowal made when some doubt as to the propriety of the admission seems to be felt, and the subject is disposed of by the following remark. "This is an inquiry which I do not mean to inflict upon my readers. It is of more interest to the student of anatomy than to the general public," probably this is the case, possibly it is not of great interest to either, but how about the rower? It is with him we are now concerned, and we opine it is to him of very great importance indeed.

While we are engaged in fault-finding we will go as far as the paragraph following that from which we have just quoted, and in which we find the same kind of partial reasoning. He proceeds to say:—

> "Let us then consider in what way the chest is affected by bodily labour, when the muscles are called into activity, whether in rowing, or running, or in such a course of gymnastics as is now wisely required for young recruits. We find that, in the first place, the parts more especially exercised acquire additional bulk, grow both larger and stronger; and secondly, we observe that the circumference of the chest is increased, it becomes wider and deeper. I have looked over numerous statistics so tabulated as to show the physical value of gymnastic instruction, and these tables all agree in showing that there is under such circumstances a coincident development both of muscle and of chest."

No doubt "the statistics so tabulated" give the results which the author has seen, for are not such statistics, after being inspected by the medical officers of the army, regularly forwarded to the Adjutant-General of the forces for his information? but what has this to do with boat-racing or running? These three exercises are as different in character and as different in their demands upon the physical energies of the human body in their practice, and in the results of their practice, as it is possible to conceive; and who that had investigated these three modes of muscular exertion would thus run them together for the purpose of showing their value or the results of their practice on the development of the chest? If the development of the chest is mainly due to the muscular exertions of the arms, how can running develop it, unless a man run upon "all fours?" When organising this "course of gymnastic instruction for recruits," we held ever before us a principle precisely the opposite to that which regulates either good running or rowing. In these, *sameness* of action, from the start till the close of the exercise, prevails; in the gymnastic course it is *variety*, the course embracing several hundreds of exercises, requiring different degrees of effort, executed at different rates of speed, employing every portion of the frame, and notably the upper limbs and trunk of the body—exercises all tested and proved to accomplish given results, on thousands of men, and over many years of careful observation, long before they were embodied by us in our military system. These three exercises should be estimated each by itself, and allowed to stand on its own feet. No real or permanent advantage can accrue to any of them by being thus lumped together, the more especially as they are in their nature so dissimilar.

ARCHIBALD MACLAREN

THE EARTH

The Earth: a Descriptive History of the Phenomena of the Life of the Globe. 2 vols., with numerous maps and illustrations.

The Ocean, Atmosphere, and Life. Being the Second Series of a Descriptive History of the Phenomena of the Life of the Globe. 2 vols., with numerous maps and illustrations. By Elisée Reclus. Translated by the late B. B. Woodward, M.A., and edited by Henry Woodward, British Museum (Chapman and Hall 1871 and 1873.)

I.

It is at length beginning to be acknowledged on all hands that no system of education can be pronounced perfect without a recognised position being assigned to the study of science. It cannot, of course, be supposed that in the ordinary *curriculum*, say of a university education, the various subjects of scientific study can obtain that exclusive attention which is required, in order to master them; but it is of the highest importance that, by the introduction and use of suitable text-books, the mind of the youthful and ardent lover of Nature in her various phases should be directed and prepared for entering upon those more minute studies and exhaustive researches in reference to particular subjects in the wide field of scientific inquiry, by which alone he can hope to force Nature to disclose her secrets.

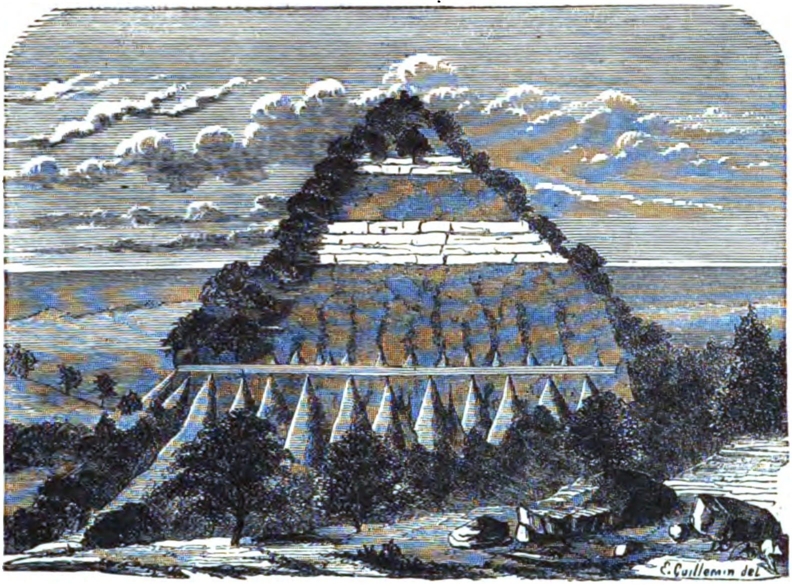
E. Guillemin del.

FIG. 1.—The Pyramid Mountain

Such a text-book we have in the work now before us—for these four volumes really form one entire work—a most admirable translation of a treatise on the earth and its phenomena by the eminent French *savant*, M. Elisée Reclus, the result of more than fifteen years' careful study, travel, and research. The translation is by the late Mr. B. B. Woodward, the Queen's librarian at Windsor Castle, and edited since his death by his brother, Mr. Henry Woodward, of the British Museum. Notwithstanding the editor's apology, the work suffers but little from its appearance in an English dress; in fact, the translation has been carried out with such remarkable success, that it possesses all the merits of an original English work. The constitution and phenomena of the planet in which we live are subjects of the deepest interest and importance to us all, and, to the earnest and thoughtful seeker after knowledge, present marvels on a scale of grandeur and magnitude far beyond the comprehension of the mere superficial observer. As M. Reclus says:—

"True enough that the earth is nothing but an almost impalpable grain of dust to the vision of the astronomer scanning the nebulæ in the field of his telescope, but it is, nevertheless, quite as much worthy of study as any other of the heavenly bodies. If it does not possess magnitude of dimensions, it presents an infinite variety in all its details. Whole generations, living one after the other upon its face, might pass their lives in studying its phenomena, without comprehending all their full beauty. There is not even any special science, having for its aim some portion of the terrestrial surface, or some particular series of its products, which does not present to our *savans* an inexhaustible field of inquiry."

The two first volumes of the work, to which alone we must at present confine our attention, consist of four main divisions—(1) on the earth as a planet, (2) on the land, (3) on the circulation of water, and (4) on subterranean forces. The first division treats of the form, structure, and motion of the earth, explaining with great lucidity the different theories respecting its formation.

M. Reclus then proceeds to give an outline of the geological history of the earth as exhibited by the stratification of rocks. In places where the strata have remained undisturbed by the action of the sleepless forces ever at work upon the earth's crust, it is possible to see the strata in their regular order of succession, giving, as it were, an abstract of the earth's geological history. Probably the most remarkable instance in point is to be found in the "Pyramid Mountain," the sketch of which is taken from the famous "Pacific Railroad Report."

The second division treats of the form and distribution of the continents, and points out the wonderful harmony and analogy which prevail in the configuration of continents and oceans, the arrangement and peculiarities of mountain ranges, the origin of valleys, ravines, gorges, and other depressions of the earth's surface. The question of the origin of mountains and valleys is still, generally speaking, an open one amongst geologists; but, nevertheless, with regard to valleys and ravines, one can in many cases distinctly perceive that their formation is due to the ceaseless action of water through countless ages, mountain torrents cutting their way even through vast mountain chains. Nothing can convey a more impressive idea of the tremendous power of water as a natural agent, than the wonderful cañons of Mexico, Texas, and the Rocky Mountains, where the torrent may be seen rushing along through the incision it has cut out for itself in the hard rock at a depth of several thousand feet between perpendicular walls. The greatest of these cañons, that of the Colorado, is 298 miles in length, and its sides rise perpendicularly to a height of 5,000 or 6,000 feet. Valleys at their commencement usually assume the form of amphitheatres in a degree more or less marked. The most regular in form are to be seen in the Central Pyrenees. "The most remarkable, on account of their vast dimensions and the snow-clad terraces which surround them, are the *oules* (boilers) of Garvarnie, Estaubé, and Troumouse, which the slow action of centuries has hollowed out in the calcareous sides of the mountains of Marboré. Undulating tracts of pasture-land furrowed by torrents, prodigious walls rising to 1,500 or even 2,000 or 3,000 feet in almost perpendicular height, gigantic steps on which whole nations might find room to sit, cascades which either spread out over the precipice and float away in a diaphanous veil of mist, or rush down into the valley like an avalanche; the high summits, glittering with unstained snow, which rear their heads high above the wall of cliffs, as if to look over the inclosure—all these features we find combined far in the recesses of these solitary mountains, so as to render the Pyrenean amphitheatre one of the grandest *tableaux* in Europe." In the third division, on the circulation of water, the author discusses at considerable length the phenomenon of snowfall on mountain heights, the successive stages through which the snow-field passes into the glacier form, the structure and phenomena of glaciers, subjects towards the elucidation of which Prof. Tyndall has made such valuable contributions. The cause of the intersection of crevasses in glaciers is fully explained. A marginal crevasse, as is well known, first appears in a direction tending up the stream of the glacier; it is then carried round by the current until it inclines in a downstream direction, and is then intersected by another crevasse opening like the first in an up-stream direction. The process is repeated until the numerous intersecting crevasses form a complete labyrinth.

After several very interesting chapters upon the subject of springs in their different varieties, the remainder of this division is devoted to the discussion of lakes and rivers, and here we find the fact carefully explained and illustrated that the hydrographical systems in different parts of the world exhibit the same relative harmony and order as the forms of the continents. The chapters explaining the process of the formation of deltas, by what are aptly termed "working rivers" (*fleuves travailleurs*), are especially worthy of attention, and will be found to contain a collection of maps and diagrams in illustration of this branch of the subject.

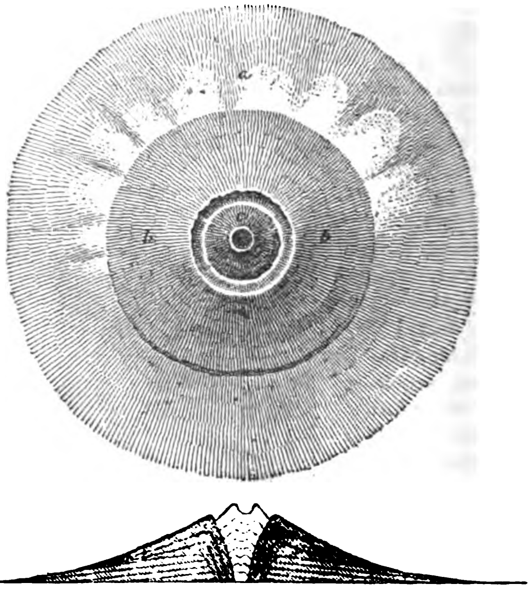

Fig. 2.—Plan and section of the volcano of Rangitoto.—*a* Declivities of tuff; *b* Cone of lava: *c* Pyramid of Scoriæ.

The last division, on subterranean forces, contains some of the most interesting chapters of the whole work, being devoted to the consideration of the most mysterious and appalling of terrestrial phenomena, namely, volcanic eruptions and earthquakes. Science has not yet succeeded in establishing any definite theory respecting the origin of volcanic eruptions, although most valuable contributions have been made to this branch of scientific study by Prof Palmieri, who so courageously stuck to his observatory on Mount Vesuvius throughout the whole of the tremendous eruption of 1872. The symmetrical form of the craters of many volcanoes is very remarkable, in some instances the outline of the cone and crater being absolutely perfect in its symmetry, as in the case of the volcano of Rangitoto, of which a plan and section here reproduced is given in the work.

Our space forbids our entering more fully at present into the merits of these interesting volumes. G. I. F. C.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Dana on Corals

A Reply to the Criticism of Mr. Duncan

In a criticism of Prof. Dana's work on Corals and Coral Islands, printed in a recent number of Nature (vol. vii. p. 119), Mr. Duncan has seen fit to mention my name and certain of my views adopted by Dana in a somewhat discourteous manner. I therefore beg leave to reply, as briefly as possible, to some of his strictures, which are both erroneous and unjust.

Concerning the general character and plan of Dana's book it is not my intention to say anything, for those are matters which chiefly concern the author and publisher. It is to be presumed that they know, quite as well as any critic, the kind of book demanded by the public—at least by the American public—and experience every day shows the errors of critics in this respect. Certainly few authors have had more extensive and successful experience in writing strictly scientific books for the public than Prof. Dana.

Mr. Duncan criticises the introduction of brief notices and descriptions of "animals which are not corals, and which in no way affect or produce coral reefs or islands," evidently alluding to the Actiniæ, Hydroids, and Bryozoa; for he says, "all the notices and descriptions of the Actiniæ and Hydroidea might have been omitted, as they only confuse the subject." Surely Mr. Duncan ought to know, and if he does, should not ignore the fact, that Millepora, and the allied genera, are true Hydroids, and at the same time form large and abundant corals, which contribute very largely to the formation of coral reefs and islands both in the Atlantic and Pacific Oceans. Moreover, this important fact is stated by Dana on page 104 of his book, and its discovery is correctly attributed to Agassiz, while the animals are illustrated by a cut copied from his figures. It should be added that this discovery, made twenty five years ago, has recently been confirmed by Pourtales ("Deep Sea Corals," p. 56, 1871). That many of the ancient fossil corals were of the same nature scarcely admits of doubt, although the writer has elsewhere shown that this was not the case with all the so-called "Tubulata." Why, then, should this important class of corals be omitted from such a work? As for the Actiniæ, their relationship to the ordinary stony corals is so close, both in external appearance and internal anatomy, that no general work on corals could be considered at all complete without an account of them. Their physiology is also much better known than that of the coral animals. Moreover, they are the only near relatives of the true corals that the majority of the readers of the book will ever see alive.

The Bryozoa are also quite entitled to the page and a half allowed them in this book, for that they do contribute something to the existing coral-reefs can be easily demonstrated. One species of *eschavella*, abundant on the eastern coast of the United States, forms solid coral-like masses often two or three inches in diameter, which accumulate in large quantities over wide areas, and, under favourable circumstances, would form limestones of considerable thickness. Some of the coral-reef species grow still larger and occur in profusion. In the Palæozoic coral-seas and reefs the Bryozoa were of still greater importance, and some of the so-called "true corals" of those times evidently belonged to this group in addition to those usually referred to it. The stony Algæ also, are by no means to be ignored in treating of coral reefs, and the half page devoted to them might well have been extended rather than omitted. Darwin, Agassiz, Major Hunt, and others besides Dana, have recognised their agency in furnishing calcareous matter to the reef limestones. Fine specimens of such limestones, composed almost entirely of their remains, may be seen in many American museums.

Mr. Duncan, in criticising Dana for adopting the classification which he believes most natural, makes this remark: "The introduction of American novelties to the exclusion of well-recognised European classifications, is neither right nor scientifically correct." Are we to infer from this that "American novelties" are less valuable than French or English ones, providing they be equally true to nature? Or does our critic prefer European error to American truth? Certainly no one has contributed more, in the way of original investigations and discoveries, to a true classification of the corals than Dana himself, in his great work on the Zoöphytes of the U.S. Exploring Expedition, which was far in advance of any work on this subject that had been written in Europe up to that time (1846). In some respects his classification was far more natural than that proposed afterwards by Edwards and Haime. Unfortunately at that period most of the corals and polyps in European museums had not been described or figured by European writers in a manner accurate enough to make their identification possible, or even, in many cases, to show their generic and family characters. That Edwards and Haime, having access to those collections, and having the benefit of Dana's great work, should have been able to make corrections and improvements was natural. Nor was it less natural that, after the publication of the more accurate descriptions and figures in their works, an American, having these and all the other works at hand, with constant access to the original types of Dana, to the unrivalled collections of corals brought together by Agassiz, and to all the other collections in the United States (by no means few or small) should, after devoting a large part of his time for twelve years to the special study of corals, have been able to make still other corrections and improvements, even in opposition to the views of certain European writers. But several European authors have also made numerous changes in the system of Edwards and Haime, and are likely to make many more. Certainly the time has not yet come when we can consider the classification of corals permanently fixed.

Whether the "novelties" to which he refers be "scientifically correct" is quite another question, and one that must be settled in the scientific way, by the evidence of facts observed, and not by denunciations, nor by dogmatic assertions. In selecting examples of the supposed inaccuracies of my views, as adopted by Dana, Mr. Duncan cites the "Oculina tribe," which the writer has established to include not only the Oculinidæ, but several other families, referred by Edwards and Haime to the Astræidæ and elsewhere. He says—"The admission of Orbicella, which is really the old Astræ of Lamarck (not of 1801), and of Caryophyllia into this well-differentiated tribe, is simply absurd, for they possess structural characters sufficiently diverse as to place them in different families." As a matter of fact, the writer has placed these same corals in different *families* in several papers published during the past five years, and this is the view adopted by Dana; so the argument quoted becomes "simply absurd." Again, he says that "Astrangia was well differentiated long before Prof. Verrill was heard of," and adds that Conrad Lonsdale and "the distinguished French Zoöphytologists consolidated the genus, which has nothing in common with the Oculinidæ." What he means by "consolidated" in this connection, it is difficult to tell, for all that Conrad and Lonsdale did was to describe very poorly, under the name of "Astræ," two or three fossil species, which Edwards and Haime afterwards referred doubtfully to Astrangia. The genus itself was first pointed out by Dana in 1846, and named Pleiadia, as stated in his book, page 68; but it was not at that time strictly defined, for there were no species in the collections of the Exploring Expedition; consequently the name Astrangia, proposed two years later, has been universally adopted. Dana's original specimens, with the MS. names placed upon them in 1845, still exist in our collections. But what my own age or reputation in the year 1848 has to do with the matter is not obvious. I trust that even then I was old enough to have seen the absurdities of such a criticism as that under discussion. That I have, since that time, carefully studied sixteen species of that genus and described a large number of new ones, while only three were known to Edwards and Haime, is true. That I have shown the close relationship between this genus and Cladocora and Oculina is equally true, and I presume that had Mr. Duncan enjoyed as good opportunities as I have had for studying this and all the related genera he would long ago have arrived at the same conclusions. It is certain that the soft parts of Astrangia, Cladocora, Oculina, and Orbicella are almost identical in all essential points of structure and form, as anyone may see by examining the published figures of the animals of these genera, though the living animals resemble one another much more closely than do the figures. Moreover there are species of Astrangia that bud laterally and grow up into branched forms not unlike Oculina, while the species of the latter are always encrusting while young, and have marginal buds, like the typical Astrangiæ, and some Oculinæ remain permanently nearly in this condition.

Nor do the internal structure of the corals afford any marked and constant characters for their separation. The Cœnenchyma is often nearly wanting in Oculinidæ, though usually characteristic, and it is sometimes present in Astrangiæ, even presenting the radiating surface lines so characteristic of Oculina. In fact it often requires very careful study to determine whether certain specimens belong to Oculina and Astrangia. Such are the genera that have "nothing in common." The relations between Caryophyllia and Astrangia, through Paracyathus, Phyllangia, &c., are sufficiently obvious, and as I have fully discussed all these relations elsewhere (Trans. Conn. Acad. I. pp. 512 to 540, 1869), it is unnecessary to say more upon this point.

What Mr. Duncan means by saying that *Caryophyllia Smithii* was first discovered by the *Porcupine* Expedition in the European seas, is not evident, if he means the well-known species which has passed under that name in all English works, and which Dana illustrates by a figure copied from Gosse's "Actinologia Britannica" (which is the only figure that Mr. Duncan specially criticises). He also finds fault with Dana for saying that *Caryophyllia cyathus* is "widely distributed over the bottom of the Atlantic, even as far north as the British isles," and tells us that "those unrecognised workers have shown that it is not *Caryophyllia cyathus* but *C. clavus* which has the great horizontal range," referring of course to the "workers" who had described the corals of the *Porcupine* expedition. But in Mr. Duncan's paper on those corals (Proc. Royal Soc., 1870, p. 289) he united both those species, together with *C. Smithii* and *C. borealis*, as mere varieties of one species, and makes a long argument to sustain that view, and concludes thus: "I have placed the species borealis in the first place, and regard the old species *C. clavus*, *C. Smithii*, and *C. cyathus* as varieties of it." Dana's statement was doubtless based on Mr. Duncan's assertions, in the paper quoted, that *C. cyathus* and *C. clavus* are identical, and the subsequent discovery of *C. clavus* in the Straits of Florida by Pourtales. The error, therefore, if such it be, belongs wholly to Mr. Duncan, and his remark that "had Dana waited a little longer he would have had the opportunity of quoting correctly," was, to say the least, quite uncalled for, and unbecoming to him. But the peculiar injustice of the critic is, perhaps, best seen in his studied omission of any credit to Dana for his extensive original observations and investigations upon the structure and formation of coral reefs and islands, and his intimations that the facts and theories are mostly borrowed. Thus he says, "The chapters on the structure of coral reefs and islands add little to the knowledge which Darwin and Jukes and Hochsteth have given us; but Dana's great powers of illustration enable him to reproduce the details with which we are so familiar—thanks to these authors—in very engaging forms." Dana has given Darwin full credit and well-merited praise, both in the preface and in many places in the body of the work, for his accurate observations of facts and discovery of the true mode of formation of coral islands; but he also states the well-known fact that his own observations had been made and his report written, in 1842, before the publication of Mr. Darwin's work. The report of Mr. Jukes was published still later (1847). Dana's observations were, therefore, wholly original, and relate mostly to regions not visited either by Darwin or Jukes. The chapters upon this subject are, as they purport to be, mainly a reprint of Dana's original report, with such additions from other and later sources as seemed necessary to make the work complete, all of which are credited to their original authors. In the preface the author says, "The observations forming the basis of the work were made in the course of the Wilkes Exploring Expedition around the world, during the four years from 1838 to 1842." Had Mr. Duncan taken the trouble to examine the original report, he would have found there the true source of most of the facts narrated. The figures of corals were also mostly copied from those in the atlas of his report on zoophytes, which were originally drawn by Dana himself from Nature, so that it is not strange that "some of them are very correct representations of Nature." When the figures are not original, their source has invariably been given. The charge that Dana does not give due credit to others is simply ridiculous, and in no case more so than when he is accused of treating the works of Edwards and Haime with "supreme contempt, inasmuch as he rarely gives them credit for their good work," for in the list (p. 379) of the species of corals described in his great work on Zoophytes, prepared at his urgent request by the writer, he has adopted, without hesitation, all the numerous rectifications made by them, as well as those made by the writer and others. A considerable number of corrections also appear in that list for the first time, and it must, therefore, be quoted as the original authority for such changes. Nothing less than the complete absence of personal vanity and pride, and entire devotion to the advancement of scientific truth, for which Prof. Dana is so justly distinguished, could have induced him to have published such a list in this book. No doubt instances may have occurred in which he has unintentionally overlooked writings of more or less importance. If so, he will doubtless make amends in the next edition. The authority for well-known facts is not always given, because such references would uselessly encumber the book. In other cases, where to mention would be only to condemn, such references have been intentionally omitted when they would have served no useful purpose. Such was the case in respect to the various erroneous European classifications, which were not adopted. Such was also the case when, in describing the extensive coral reefs of Brazil, so well explored by Prof. Hartt, and which were shown by the writer to consist of corals related to and partly identical with those of the West Indies, he does not refer to Mr. Duncan's assertion (Quar. Jour. Geol. Soc. xxiv. p. 30) that "the Orinoco drains a vast tertiary region, and shuts in the coral-life of the Caribbean on the south;" and that "the Florida reefs consist of few species," when more than forty-five species had even then been recorded from them, or more than he admits for any existing reefs. Other statements and theories concerning the recent and fossil corals of the West Indies, in the same paper, have become equally absurd, in consequence of the recent discoveries of Pourtales, and needed no exposure. His assertion that the isthmus of Panama was deeply submerged during the Miocene, and again forcibly urged in his criticism of Dana, may rest on no better foundation than the other assertions just quoted from the same paper, notwithstanding the careless way in which he misquotes, as to place of publication, and misrepresents, as to the contents, a brief article in opposition to that view by the writer. We still look in vain for such proofs as would be afforded by elevated coral reefs having relations to those of the West Indies, but situated on the Pacific side, or even upon the higher parts of the isthmus. The well-known existence of elevated coral reefs in the East Indies and Polynesia, and their presence in the West Indies, known long before Mr. Duncan began to write his valuable papers, proves nothing of the sort. Whatever relations do exist between the fossil corals of the East and West Indies can be easily explained in other ways. We think it singular that while certain geologists find it necessary to force the Gulf-stream across the isthmus during the warm Miocene, others find it quite as important to turn it out of the Atlantic, across the isthmus, during the glacial period. Both assumptions seem equally gratuitous, and may be opposed by numerous facts.

A. E. VERRILL

Animal Instincts

ALLOW me to add two or three facts to the interesting store supplied by your correspondents.

Some years ago a dog was sent to me at Taunton from Honiton, distant seventeen miles. It was conveyed in a closed hamper and in a covered cart. It escaped from my stable on the evening of its arrival, and at 11 o'clock on the following morning it was at its home again. The route lay over a ridge of steep hills.

Mr. Robert Fox, of Falmouth, so well known to the scientific world, is my authority for the following:—The fishermen of Falmouth catch their crabs off the Lizard rocks, and they are brought into the harbour at Falmouth alive and impounded in a box for sale, and the shells are branded with marks by which every man knows his own fish. The place where the box is sunk is four miles from the entrance to the harbour, and that is above seven miles from the place where they are caught. One of these boxes was broken; the branded crabs escaped, and two or three days afterwards they were again caught by the fishermen at the

Lizard rocks. They had been carried to Falmouth in a boat. To regain their home they had first to find their way to the mouth of the harbour, and when there, how did they know whether to steer to the right or to the left, and to travel seven miles to their native rocks?

Another, of which the drover is my informant. Large flocks of sheep are driven weekly from the Welsh hills to the London market. Some time since two escaped in the dark and were supposed to have been stolen. About a fortnight afterwards the two stray sheep reappeared on the Welsh mountains, whence they had been brought. They had found their way through a journey of at least 100 miles. My informant learned from some of the turnpike-gate keepers on the road that, when opening the gate at night to a traveller, two sheep had been seen to rush through.

The nightingale returns from Greece, not merely to the same country, but to the same field and the self-same bush. The swallow takes possession of the same nest.

EDWARD W. COX, Serjeant-at-law

Carlton Club, March 31

The Sociability of Cats

IT may prove of interest to naturalists to record the following curious instance of the social habits of cats:—

I once had two she cats that were upon very intimate terms with each other, always together, and never appeared to have quarrelled. At one time, one of them being about to add an increase to their number, the other very kindly nursed it, and even performed the function of a midwife, and actually attended to the necessary offices that are in ordinary cases attended to by the parent of the progeny. Feeling some interest in curiosities of natural history, I carefully watched my pets, and can therefore vouch for the truthfulness of this extraordinary manifestation of feline sociability.

I may here mention that, as regards the teachableness of cats, I once saw at the house of an intimate friend a fine, large tabby tom-cat put through a drill which would perhaps outvie similar exhibitions of the genus *homo*. He was told to "stand up," "shoulder arms," "present arms," and "stand at ease," which, by observing the hands of the master, he would most obediently do, and with a promptness that was astounding. Another cat was told "to beg," which it at once did by jumping on to a Windsor chair, and performed some curious twistings and rollings that were continued until the morsel of meat was awarded. I have recently introduced a fine kitten to the company of two cats I have had for years. For a long time a deadly feeling of enmity was maintained against the stranger; but now, after a period of three months, the two older cats will not lap their morning's milk until the kitten is in their company; if absent, they actually retire, and refuse to take their meal.

Red Lion Street, March 26 J. JEREMIAH

Manitoba Observatory

HAVING seen in vol. vii. p. 289 of NATURE a statement to the effect that the American Government had established an observatory at Fort Garry, Manitoba, I have to inform you that the so-called observatory is a telegraph reporting station maintained by the Dominion of Canada. Its tri-daily reports, however, in common with those from several other Canadian telegraph stations in correspondence with Toronto, are always placed at the disposal of the Washington weather office.

G. T. KINGSTON

Magnetic Observatory, Toronto, Canada, March 11

ST. THOMAS CHARTERHOUSE TEACHERS' SCIENCE CLASSES

PRIOR to the introduction of Mr. Lowe's revised code, elementary science teaching was always to be found in the curriculum of our best primary schools. The properties of water, the constituents of some of the chemical elements, the first principles of mechanics and the like, were taught with much pleasure by the masters of the schools above alluded to "Payment by results" on the three R's threw cold water upon this class of intellectual teaching, and it has only been revived recently through agitation emanating from enlightened educators. Teachers of late years too have had their studies very much limited by the low requirements of the Education department, and hence many young teachers were launched out into the teacher's profession unable themselves to impart instruction formerly given in our schools. Teachers have long been clamorous for having the standard of education raised in their schools, and have therefore hailed with great satisfaction the act of the Science and Art Department whereby additional grants are given to any pupils or adults or juveniles who could, after receiving a certain number of lessons from a qualified teacher, pass an examination on the subject-matter of these lectures. Teachers, however, before they are permitted to give these lectures to pupils, are required to pass an advanced examination on the subjects they propose to teach. To enable teachers to pass these tests, the St. Thomas Charterhouse Teachers' Classes were inaugurated in October last. The idea was organised by Mr. C. Smith, one of the teachers and organising secretaries, and was carried out under the auspices of the Rev. J. Rodgers, M.A. To the credit of our primary teachers it ought to be added that they have since the promulgation of the idea worked most heartily to bring it to this desired consummation. Profs. Huxley, Ansted, Carruthers, Sir John Bennett, and several other scientific men joined the committee for carrying out the classes. From every part of London masters and mistresses of our elementary schools gladly joined the Science School. Over 230 teachers were initiated, and it is hoped that most of the teachers will qualify themselves in the coming May examination to be able to teach the science subjects they have studied in these classes. Thus from this nucleus it is thought that next year we shall have science classes in connection with nearly every school (elementary) in the metropolis; and undoubtedly in a year or two more the inculcation of elementary general science knowledge will be almost universal.

Science teaching in the hands of a skilful instructor is always popular with young people, and as elementary teachers are eminently successful as collective teachers of the young, who could be better entrusted with imparting instruction which so brightens the intellect as these educators? The chief subjects taken this year at this science school are chemistry, mathematics, acoustics, light and heat, magnetism and electricity, botany (systematic and economic), geology, physiology, plane and solid geometry; but next year the promoters of the scheme hope to have classes in all the twenty-five subjects recognised by the Science Department of the Government. Most of the present students of the classes go in vigorously for physiology, physical geography, and acoustics, light and heat, a great many for chemistry. The teacher of chemistry, Mr. Spratling, has got up a first-rate laboratory for chemical experiments. Mr. Payne, teacher of magnetism and electricity, has all the approved auxiliaries for performing experiments connected with this subject. Next year the biology students will have every facility afforded them for microscopical practice. Mr. Simpson, who has done at least as much as any other person in London to train science teachers, is engaged as the special lecturer on Biology.

During the present session several of our leading scientific men have given a professional lecture to stimulate the teachers in their studies. Dr. Gladstone, Dr. Jarvis, Prof. Ansted, Prof. Carruthers, Mr. Tylor, Rev. W. Panckridge, Prof. Skertchley amongst the number. All the ordinary lectures are given by elementary teachers who have qualified themselves to teach. Two of the students, Mr. Bird and Mr. Powell, who have spent some of their leisure moments in making observations in botanical science, render much valuable aid to their fellow students in furnishing examples to illustrate the lessons given in botany. The students generally are pursuing their studies with great avidity, and as was observed at the Devon Social Society Gathering, by Mr. C. Clarke the importance of these classes cannot be over-estimated

*TROGLODYTES OF THE VEZERE**

IV.

IV.—*Arts among the Troglodytes*

THE men of the reindeer age cultivated drawing, chiselling, and even sculpture. We must admit that they had, like ourselves, many inferior artists; but among a large number of coarse attempts, such as our "street arabs" chalk on the walls, there are some really remarkable ones, which denote at the same time a clever hand and an eye practised in the observation of nature.

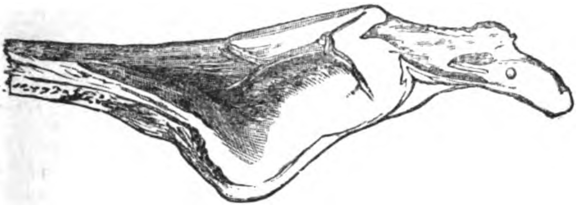

FIG. 23.—Sculptured pointed handle, representing an elongated reindeer.

Drawing, with this people, evidently preceded sculpture. The figures in relief are much more rare among them than those that are carved, and likewise much less perfect. The latter are common at the Eyzies and Lower Laugerie, but they abound more especially at the Madelaine, where they are also much more correct. These drawings are all carved. Most of them ornament the surface of different objects in deer horn, such as batons of command, handles of poignards; but some are engraved on pieces of stone, ivory, or deer horn, which were not intended for any other use, and which were prepared purposely to receive the work of the artist. (See Figs. 12 and 22.)

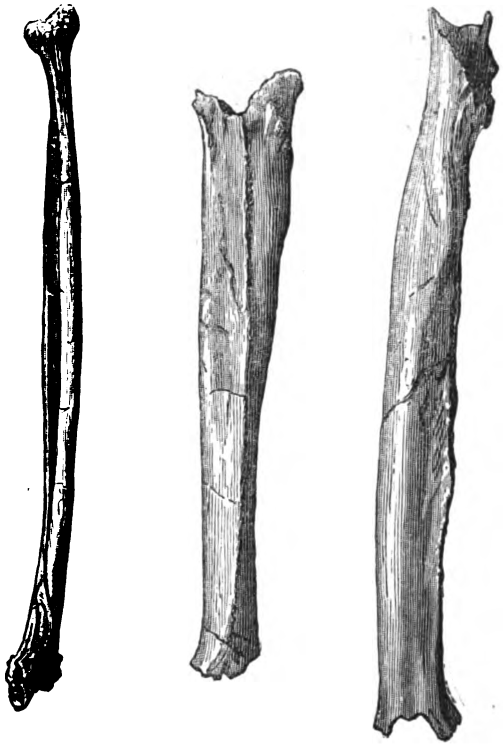

FIG 24. FIG. 25. FIG. 26

Bones of the old man of Cromagnon. Fig. 24—Shin-bone. Fig. 25.—Flattened tibia. Fig. 26.—Femur: profile view.

Nearly all these drawings represent natural objects. Some, however, are merely simple ornate lines, forming zigzag festoons, and more or less elegant curves.

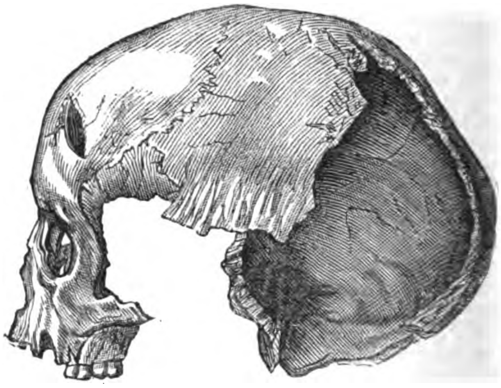

FIG. 27.—Skull of the woman of Cromagnon: profile. The wound in the frontal bone is shown.

Three little roses carved on a handle in deer-horn, seem to represent a polypetalous flower. All the other drawings are representations of animals.

The most numerous are those of the reindeer, then those of the horse: the ox and the aurochs are less common. These different animals are easily distinguished, their ways, their movements are sometimes reproduced with much elegance and accuracy; often they are isolated, dispersed in apparent disorder and in numbers over the whole surface of an object; then again they form groups, they are seen fighting together (see Fig. 22), or fleeing from man.

Of all these drawings, the most important and also the most rare, for it is at present unique, is that which represents the mammoth, and of which I have already spoken.

Drawings of fish are pretty common. With one exception, which represents an eel or a lamprey (if it is not a serpent), they have a shape which, though not very characteristic, may be intended for a salmon.

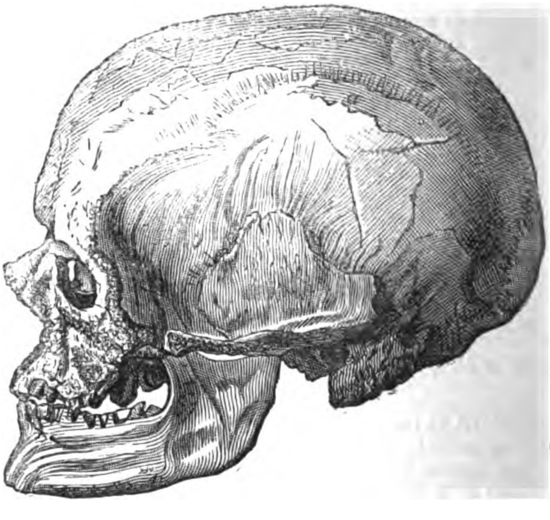

FIG. 29.—Skull of the old man of Cromagnon: profile.

The Troglodytes, sometimes so clever in delineating animals, were very inferior artists of the "human form divine;" they very rarely studied it. Only one study of a head has been found; it is a very small drawing, representing a grotesque profile. Two other drawings, pretty much alike, represent the forearm terminating in a hand with four fingers, the thumb being hidden. I have already told you that the pieces of sculpture are much more rare than the drawings. There are not more than half a dozen, and they all come from Lower Laugerie. One of them, belonging to the Marquis de Vibraye, represents a woman, another represents a reindeer (see Fig. 23).

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* Continued from p 369

V.—*Race*

To complete the study of this interesting people, I should now like to be able to characterise the race to which they belonged. The human bones that have been collected up to the present time are not, unfortunately, sufficiently numerous to satisfy our curiosity. However they suffice to prove that this race was very different from the succeeding ones, and to prove above all how much the learned anthropologist Retzius and his disciples were deceived, in stating that all the population of Western Europe, before the comparatively recent epoch of the Indo-European emigrations, belonged to the type of *short heads* or *brachycephals*.

M. Elie Massenat discovered, some months ago, at Lower Laugerie, the skeleton of a man who appears to have been buried in a landslip. But the anatomical description of this precious skeleton has not yet been published; and I regret it the more, that it is the only discovered remains of the Troglodytes of the latest epoch.

The skulls and bones, of which I show you the models, belong to a much earlier date. They were found in the ancient burying ground of the station of Cromagnon, of which the geological, palæontological, and archæological characters have been ascertained with the greatest nicety by M. Louis Lartet. This sepulchre, henceforth celebrated, contained the remains of at least five people. But only three skulls, two male and one female, were sufficiently well preserved to make useful studies. One of the men had attained a great age; the other man and the woman were adults; near them lay a young child. Their stature was very lofty, and far superior to our own. The length of the femur of the old man indicated a height of more than 1·80m. The volume of the bones, the extent and roughness of the surfaces of muscular insertion, the extraordinary development of the branch of the jawbone, where the masticatory muscles are inserted, prove an athletic constitution.

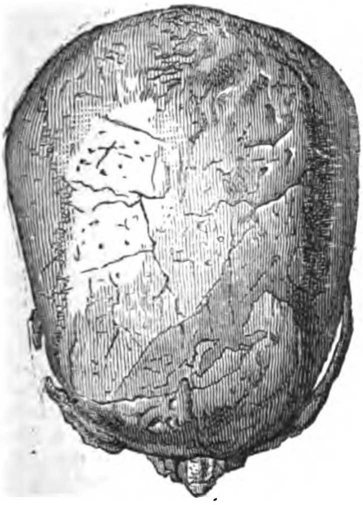

FIG. 31.

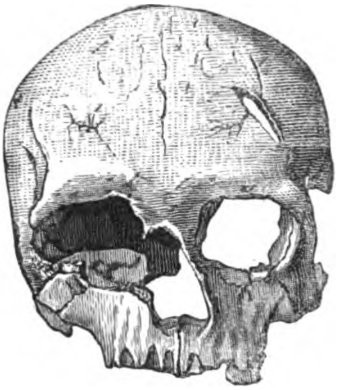

FIG. 28.

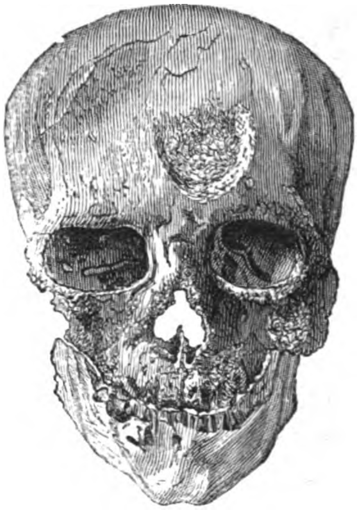

FIG. 30.

Fig. 28.—Skull of the woman of Cromagnon : front view. Fig. 30.—Skull of the old man of Cromagnon : front view. Fig. 31.—Skull of the old man of Cromagnon, *Norma verticalis*

The tibias, instead of being triangular and prismatic like our own, are flattened like those of the gorilla (see Fig. 24. The upper part of the cubitus, very powerful and arched, supports a very small sigmoidal cavity, and its characteristics again recall the shape of the gorilla. But the conformation of the femur differs radically from that of the monkey tribe. The femur of anthropomorphal monkeys is flattened from front to back—that is to say, much wider than it is thick, and it does not present, on its posterior surface, that longitudinal elevation which in man is called the *rough line*. In the existing human races, the thickness of the femur is in general rather greater than its width, but the difference is inconsiderable. At Cromagnon this bone is much thicker than it is wide (see Fig. 25). The rough line, enormously developed, is no longer a simple elevation; it is a regular bony column, thick and projecting, which considerably augments the solidity of the bone and the extent of the muscular insertions. In this respect, therefore, the Cromagnon race differs much more from the Simian type than do the existing races. The skeletons of these robust Troglodytes bear the traces of their deeds of violence. One of the femurs of the old man presents, towards the lower extremity, a cavity such as is sometimes produced by our musket balls. It is evidently the result of an old wound. It was evidently a human hand, armed with a flint weapon, which produced a long penetrating wound on the skull of the woman. The width of the opening shows that the weapon must have reached the brain. This inglorious murder of a woman does not shed lustre on the people of Cromagnon. The study of their industry has already proved that their social status was not above that of other savage nations. An examination of their skulls confirms this notion.

With them, the sutures of the anterior region of the cranium are very simple, while those of the posterior region are rather complicated; besides which the former have a manifest tendency to close long before the latter. These two characteristics are observable in people and in individuals who live principally an animal life. The Cromagnon Troglodytes were then savages. But these savages were intelligent, and open to improvement; side by side with the proofs of inferiority I have just given, we find among them sure signs of a powerful cerebral organisation. The skulls are large. Their diameters, their curves, their capacity, attain, and even surpass, our medium skulls of the present day. Their form is very elongated. The alveolar process of the old man is oblique, but the upper part of the face is vertical, and the facial angle is very open. The forehead is wide, by no means receding, but describing a fine curve; the amplitude of the frontal tuberosities denotes a large development of the anterior cerebral lobes, which are the seat of the most noble intellectual faculties. If the Cromagnon Troglodytes are still savages, it is because their surrounding conditions have not permitted them to emerge from barbarism; but they are not doomed to a perpetual savage state. The development and conformation of their brain testify to their capability for improvement. When the favourable opportunity arrives, they will be able to progress towards civilisation. These rough hunters of the mammoth, the lion, and the bear, are just what ought to be the ancestors of the artists of the Madelaine.

I have just glanced over the principal facts in the history of the Troglodytes of the Vézère. For want of time, I have been obliged to shorten several and omit a number more. I hope, nevertheless, that you have been able to follow with me from Moustier to Cromagnon, from Cromagnon to Upper Laugerie and Gorge d'Enfer, and from thence finally to the three stations of the Eyzies, Lower Laugerie, and the Madelaine; the progressive evolution of an intelligent race, which advanced step by step, from the most savage state to the very threshold of civilisation. The Troglodytes of the latest epoch had, so to speak, but one step to take in order to found a real civilisation, for their society was organised, and they possessed arts and industry, which are the two great levers of progress.

This people have, nevertheless, disappeared, without leaving a single trace in the traditions of man. They did not die off by degrees, after having passed through a period of decadence. No, they perished without transition, rapidly, perhaps suddenly, and with them the torch of the arts was suddenly extinguished. Then began a dark period, a sort of middle ages, the duration of which is unknown. The chain of time becomes broken, and when we seize it again, we find, in the place of the reindeer hunters, a new society, a new industry, a new race. They are beginning to understand agriculture, they have some domestic animals, they are raising megalithic monuments, they have hatchets of polished flint. It is the dawn of a new day; but they have lost every remembrance of the arts. Sculpture, drawing, ornamentation, have alike disappeared, and we must descend to the later period of polished stone to find, here and there, on the slabs of some very rare monuments, a few ornamental lines which have absolutely nothing in common with the remarkable productions of art among the Troglodytes. The extinction of the Troglodytes was so complete and so sudden that it has given rise to the hypothesis of an inundation; but against this geology protests, and, to explain the phenomenon, we need only refer to the influence of man himself. Our peaceable reindeer-hunters, with their gentle manners, their light weapons, which were not adapted for fighting, were not calculated to resist the invasion of barbarians, and their growing civilisation succumbed at the first shock, when powerful conquerors, better armed for war, and already provided perhaps with the polished hatchet, came to invade their valleys. It was then seen, as it has often since been proved, that might conquers right.

PROF. FLOWER'S HUNTERIAN LECTURES

LECTURES XVI. XVII. XVIII.

ARTIODACTYLATA. The peculiarities of the skeleton in these animals have been already pointed it; it may be added as a constant special character, at the lower end of the fibula articulates with the calneum as well as with the astragalus; the premolars are also simpler than the molars, and there is an extra lobe to the last milk molar. The number of existing species is very great; they tend to divaricate in two directions, one culminating in the Pigs, and the other in the Cavicorn Ruminants. The Hippopotamus and Chevrotain at first sight do not look much alike, but the links between the two are very complete. The existing species are the most differentiated members of the order. Of the *Suinæ*, the Pigs are very exceptional among existing mammalia in retaining the typical number of forty-four teeth, Gymnura, an insectivorous animal, alone resembling them in this point; however there are spaces between some of them, so they do not form a regular series. The upper canines are very peculiar in being directed upwards instead of downwards, and in the Babirussa, where they pierce the upper lip, this is carried to an extreme. The molars are tuberculated, the tubercles being four in number in the Peccary, but much more numerous, especially in the last molars of *Sus*, where the extra ones represent the third lobe of the same teeth in the Ruminants. In a fossil pig from Pikermé the canines were similarly developed in both sexes, so the sexual differentiation must have been of later origin. In the Wart-hogs the incisors are rudimentary, and late in life the only molars persisting are the enormous columnar last molars; the great size of the canines is well known.

In the true *Ruminantia* there are no upper incisors, and the canines are but rarely developed. In the lower jaw there are eight teeth in a row along the front of the mouth, the two lateral can be proved to be canines, because in older types they are found of a different shape from the six true incisors. The anterior premolar is never developed. Kowalevsky has recently given the names *Bunodont* and *Selenodont* to the non-ruminating and ruminating members of this class, on account of the differences exhibited by their molar teeth, those in the latter presenting the ridges as a double crescent instead of in tubercles. The temporal bone and its surroundings give excellent characters whereby to separate these sub-classes; the shape of the glenoid cavity and the direction of the external auditory meatus differing considerably in them. There is also no lateral notch in the palate of the pigs like those in the Ruminants. The Cervidæ and Cavicorn Ruminants also have the odontoid process of the axis peculiarly spout-shaped, whilst in the pigs it forms a simple peg, much as in man. It does not seem to have been remarked before that in this respect the *Tragulidæ* differ from the typical Ruminants, and resemble the pigs, the odontoid in them being a peg. With regard to the feet of *Sus*, Dr. Kowalevsky has made some important observations, having shown that the approximated sides of the two median metacarpals, which are the largest, send in towards one another processes which interlock, and that the shape of their distal articular surfaces causes them to be pressed together when the foot is to the ground. In the pigs the fibula is separate and complete, but in the Ruminants it is represented only by a small piece of bone outside the ankle; a rudiment is sometimes present above. That the deer approach the original type more than do the antelopes is evident from the facts that the upper canines are sometimes present, the crowns of the molars are shorter, and the lateral toes are present, being best developed on the fore-limb. The *Tragulidæ* are less differentiated in having the anterior metacarpals free and the fibula entire, though slender; the canines are well developed in the male at least, and the glenoid cavity is as like that of the pig as of the deer. *Dicotyles* approaches the ruminants from the other side, the metatarsals uniting to form a canon bone, and the foot altogether closely resembling that of Hyomoschus, though an outer toe is lost in the former. The camels are developed in a different direction, approaching the more generalised type.

Artiodactylates appear first in the middle Eocene, and therefore do not go so far back as the Perissodactylata

Anoplotherium is from the upper Eocene of France and England only; there are two or three species. Though so early a form, it was much specialised, and its peculiarities have not been retained in more modern nor existing forms. It was about the size of the ass. The teeth formed an unbroken series, and, as in man, they were uniform in height. The upper molars were much as in Palæotherium, and the lower were a modification of the same type. Nineteen dorso-lumbar vertebræ were present; the tail was very long, with large chevron bones, which are not found in other Ungulata, and from which Cuvier somewhat rashly inferred that the animal was aquatic. The odontoid process of the axis was simple. In the feet there were only two toes before and behind; the metacarpals were quite separate. In one species there were four toes in front and three behind. *Elotherium* or *Entelodon* is another form from the lowest Miocene. It has been found in the middle of France and in the Mauvaises Terres of Dakotah. Its skull was elongated and somewhat pig-like, but the orbit was completed behind by bone. In size it approached the tapir. The teeth were somewhat carnivorous, the canines being long and bear-like, and the premolars trenchant; the forty-four teeth were present; the posterior molars were comparatively small, and the last one in the lower jaw had scarcely a rudiment of a third lobe. As in Anoplotherium there were only two toes on each foot, and the metacarpals and metatarsals were free.

Of the *Suidæ* many fossil species are known; the first appear in the upper Miocene of Eppelsheim and Pikermé, those in the latter locality much resembling the existing forms, the teeth only being less differentiated. There are no fossil true pigs in America. In the earlier and middle Miocene of Germany and France close allies are found in abundance, with the teeth simpler, only four tubercles being present, and the last molar not being excessively developed. One of these, *Amphichœrus*, had very long canines pointing downwards in the upper jaw. *Hyotherium* comprises *Palæochœrus* and *Chœrotherium*, the latter a small animal described by Leidy. There is a perfect transition between Palæochœrus and the fossil true pigs. Going further back it is doubtful how the line of descent continues. Acertherulum of Gervais may have had some relation to it. The American peccaries are peculiar in having only three premolars; in the fore-foot the outer toe is much reduced, and in the hind foot it is lost; a canon bone is formed by the metatarsals. Fossil peccaries have been found by Lund in Pleistocene caves of the United States, and in the American Miocene, scattered teeth of pig-like animals are not uncommonly met with.

Of recent hippopotamuses there are two species which have been further separated into different genera by Leidy, *Chœropsis* being the smaller and more pig-like; in it also the teeth are not so complicated, and it has two fewer lower incisors. In both genera the molars are very characteristic, being raised in four cusps, each of which in the little worn tooth is trefoiled on the surface; as the tooth gets more used these run together to form ultimately a single insula, undulated at the borders. In the Pleistocene caves and gravels of England, France, Germany, and elsewhere, remains of *Hippopotamus amphibius* are numerous, some are larger than existing individuals, but they do not otherwise differ. In Sicily a smaller species is found in enormous numbers. There are no hippopotamuses in the Miocene nor in the lower Pliocene. In Madagascar a smaller species used to abound. Dr. Falconer, in the Sevalik Hills, found remains of true hippopotamus with four incisors, but most from that region belonged to a distinct form in which all the six were present, and which has been named *Hexaprotodon*. There is no complete bridge between these animals and the pigs, and none have occurred in America.

Dr. W. Kowalevsky has drawn attention to an interesting point in the construction of the limbs of the different members of this class. He has shown that there are two methods by which the extremities may be supported on the carpus and tarsus respectively. In one, the *inadaptive*, the digits as they reduce in number, still are only supported by the carpals which originally articulated with them in the pendactylate foot. In the *adaptive* method, as the digits reduce, they enlarge their bases of attachment on the carpus, and so get a firmer support. This latter condition is found in all existing Artiodactylates except Hippopotamus.

Of the *Selenodonts* one of the earliest known is *Chœropotamus* from the upper Eocene of Montmartre; it was about the size of a pig, with the molars characteristic, presenting five tubercles, three in the anterior row, and two behind. *Anthracotherium* had similar molars, its limbs are unknown. *Hyopotamus* though but little known, was once very abundant; the species varied in size from that of a large rat to that of *Anthracotherium*: it is only found in the Eocene and early Miocene of Europe and North America. The molars were formed on the same principle as those in Chœropotamus, but they were more drawn out; the lower formed double crescents with an internal tubercle well developed; the typical forty-four teeth were present. Most had four toes, and feet very pig-like. Kowalevsky found some at Hordle with only two, and he has named these *Diplopus*. Between Hyopotamus and Anthracotherium there are many intermediate forms, *Xiphodon* with two toes, *Dichobune* and *Cainotherium*, this last had forty-four teeth, forming a continuous row, and three toes on the feet. *Dichodon* was a genus, named by Owen from some teeth, of which it possessed the full number, and the molars formed double crescents. From this we pass by easy transitions to the *Tragulidæ*, which have nothing to do with the Musk-deer, as is so frequently stated. They are at present confined to South Africa, South India, and the adjoining large islands. *Hyomoschus*, the African genus, has survived almost unchanged from the early Miocene period. *Tragulas* is not known fossil.

An American group here comes in to fill a gap. *Oreodon*, an animal about the size of a sheep, found in the early Miocene, is said by Leidy to be quite intermediate between the deer and the peccaries. It had forty-four teeth, its palate more closely resembled that of the deer, and the upper molars formed, as in them, double crescents. The canon bone was not consolidated, and there were apparently four toes. They closely resemble Dichodon. Leidy divides them into three genera, *Agriochœrus*, *Merychyus*, and *Oreodon*. The first of these approaches Chœropotamus, and the crowns of the teeth were very short. *Gelocus*, described by Kowalevsky, is the earliest known form in which the metacarpals coalesced to form a canon bone; it occurs in the Eocene and the earlier Miocene. Those from the former have the metacarpals always free, but in the Miocene they anchylosed in the adult animal, and in higher strata they are fully coalesced. *Dremotherium* was a form which closely approached the deer. *Cervus* proper is first represented in the upper Miocene. In the earliest forms the antlers were very small and simple, closely resembling those of the Muntjac, and having long pedicles; the canines were also developed. All the Cervidæ adhere to the old type in having short crowns and well-marked necks to their molars. The Giraffes (*Camelopardidæ*) are first known from Pikermé and the Sevalik Hills; the molar teeth more closely approached those of the deer than any other animals. *Heladotherium* is not far removed from them; it was of large size and had no horns. *Sivatherium* was the largest of the extinct Artiodactylates. Its bones were bovine in character; the metacarpals and metatarsals coalesced to form a canon-bone, and there were only two toes on each foot; four horns were present, in pairs, apparently cavicorn and yet branched.

Antelopes and Deer coexisted in the Miocene era, but most of the former are Pleistocene in date. The crowns of the molars are prolonged in all the cavicornia. The *Camels* are not directly allied to the other forms; they retain an upper incisor; their molars are in double lunules, and of considerable length. Their geographical distribution is very peculiar, they being confined to North Africa, Arabia, and South America. Dr. Falconer has found their remains in the Sevalik Hills, and Leidy has done the same in North America, naming one of his genera *Procamelus*, and another earlier one Poëbrotherium.

This ends the description of the Artiodactylata, and terminates the course of lectures.

AN ENGINEERING COLLEGE IN JAPAN

THE Japanese Government, as represented by the ambassadors who visited this country last summer and autumn, have resolved upon taking example by our western civilisation, and establishing a college in the city of Yeddo for affording instruction in civil and mechanical engineering to the youth of Japan, as a strong desire has arisen in that country to make an effort to develop the great natural resources which it is known to possess. Our advice and practical assistance in the establishment of the college have been called into requisition, owing to the ambassadors having observed during their sojourn amongst us, how intimately our eminent industrial status as a nation is dependent upon the attention which we devote to the cultivation of those sciences which are involved in the mining, metallurgical, engineering, and many manufacturing industries, and in bringing the forces of nature under the influence of man.

The general scheme of the instruction has been devised by one of our eminent engineers, a gentleman whose experience of Continental and British systems of instruction is very extensive and varied, and judging from the appointment already made, it is evident that the professorial equipment of the college will devolve upon this country. The principal of the college, who is also to be the professor of engineering and mechanics, is Mr. Henry Dyer, M.A. B.Sc., who studied at the University of Glasgow, under the late Prof. J. M. Rankine, Sir William Thomson, and their colleagues. Mr. Dyer was a Whitworth Scholar, and his career hitherto has been one of great and well deserved success. He is well qualified to act as principal of the Yeddo Engineering College.

Prof. Dyer is to be assisted in his duties in the Japanese College of Engineers by professors of mathematics, natural philosophy, chemistry, geology, and mineralogy, and by teachers of English, &c. At least two important appointments have been made, namely, to the professorship of mathematics and to the professorship of natural philosophy. The former has been conferred on Mr. D. H. Marshall, at present assistant to Prof. P. G. Tait in Edinburgh University; and the latter is to be filled by Mr. W. E. Ayrton, formerly of University College, London, and the University of Glasgow. The last-named gentleman has already been employed in the East Indian telegraphic service, and he is at present assistant-engineer in connection with the manufacture of the Great Western Telegraph Cable under Sir William Thomson and Prof. Fleeming Jenkin.

In connection with this Engineering College there are several other points of importance that may be stated. It is intended to institute a geological survey of Japan, and not improbably the active superintendence of that work will devolve upon the gentleman who may ultimately be appointed to the professorship of geology and mineralogy. As an important adjunct to the College, there will be erected a technical workshop, fitted with steam-engine, machine tools, and all the necessary appliances for familiarising the young Japanese engineers with the principles of construction, &c. There will also be a technological museum for the illustration of the progressive stages of various industrial processes from the raw materials to the finished products.

NOTES

LETTERS, dated St. Thomas, appear in the *Times* and *Daily News* from correspondents on board the *Challenger*, where the vessel arrived on March 16. The voyage from Teneriffe had occupied 30 days. The usual programme was to furl sails early in the morning of every alternate day, put the ship under steam, obtain a sounding-haul of the dredge and serial temperatures at every 100 fathoms from the surface down to 1,500 fathoms, then at dusk sail was again made. The sounding line and dredge have been kept constantly going. The former showed that a pretty level bottom runs off from the African coast, deepening gradually to a depth of 3,125 fathoms at about one-third of the way across to the West Indies. If the Alps, Mont Blanc and all, were submerged at this spot, there would still be half a mile of water above them. Five hundred miles farther west there is a comparatively shallow part, a little less than two miles in depth. The water then deepens again to three miles, which continues close over to the West Indies. At the deepest spots both on the east and west side of the Atlantic, the dredge brought up a quantity of dark red clay, which contained just sufficient animal life to prove that life exists at all depths. No difficulty was experienced in obtaining these deep-sea dredgings, and it was merely a question of patience, each haul occupying twelve hours. In depths over two miles little has been found, but that little was totally new. One of the lions of the cruise is a new species of lobster perfectly transparent. Not content with obtaining animals with eyes so fully developed that the body may said to be an appendage, a new crustacean has now dredged up, in which the body has cut itself clear of the eyes altogether, and the animal is totally blind. It has no eyes, or even the trace of an eye. To make up for its deficiency nature has supplied it with the most beautifully developed, delicate lady-like claws, if one may use the term, it is possible to conceive. Nearer the West Indies, in a depth of only half a mile, some similar creatures were brought up, and here the claws, longer than the body, are armed throughout with a multitude of spike-like teeth, looking more like a crocodile's jaw than anything else. At a short distance from Teneriffe, in a depth of a mile and a half, a rich and extremely interesting haul of sponges and coral was obtained, but the latter was unfortuately dead. It is a white species, as large and heavy as the pink coral of the Mediterranean. There are great hopes of obtaining a specimen alive. The nature of the bottom brought up and the way the trawl and dredge frequently catch in being dragged along prove, undoubtedly, that the bottom of the sea, even at great depths, is not so smooth and free from rocks as has hitherto been supposed. A conclusion drawn from this fact is that a considerable movement of the water at the bottom must be going on. The *Challenger* will remain at New York until the 25th of April, and at Bermuda until the mail arriving on the 8th of May, after which she will sail for Madeira, carrying another section line across the Atlantic.

WE have learnt with pleasure that it is contemplated to present a testimonial to Dr. Murie, in recognition of his numerous additions to our knowledge in the field of Biology. From a list before us we learn that Dr. Murie is the author of seventy-five separate works, large and small, mostly connected with zoology. An opinion having been expressed that it might not be inappropriate to present Dr. Murie with a substantial recognition of the services which he has rendered to science by his numerous memoirs printed in the Proceedings and Transactions of the Zoological Society and other scientific journals, the following gentlemen have already acquiesced in that opinion, and state their belief that Dr. Murie's career has been a most meritorious one, very beneficial to science, and highly honourable to himself. The Viscount Walden, F.R.S., President of the Zoological Society of London, Sir Charles Lyell, Bart., Charles Darwin, F.R.S., Joseph D. Hooker, C.B., F.R.S., Allen Thomson, M.D., F.R.S., G. M. Humphry, M.D., F.R.S., James Glaisher, F.R.S., W. Sharpey, M.D., F.R.S., Wm. Turner, M.B., J. Lockhart Clarke, M.D., F.R.S., W. K., Parker, F.R.S., John Young, M.D., F.R.S.E., F.G.S., George Busk, F.R.S, St. George Mivart, F.R.S., Frank Buckland, F.Z.S., Inspector of Salmon Fisheries, William Aitken, M.D., J. Bell Pettigrew, M.D., F.R.S. Prof. Turner, of the University of Edinburgh, and Dr. Bell Pettigrew, of the Royal College of Surgeons of Edinburgh, have consented to receive subscriptions with a view to furthering the above object. Intending subscribers should communicate with either of these gentlemen.

AT the close of thee winter session of the Class of Physiology in Edinburgh University last Friday, Dr. J. G. McKendrick, F.R.C.P.E., was presented with an address signed by upwards of 400 present and former students of the class. Dr. McKendrick has for the last four years held the office of Demonstrator of Practical Physiology under Prof. J. Hughes Bennett, and during that period the classes in Practical Physiology have increased, from small beginnings, till more than 400 students have been enrolled in a single session. During the last two sessions Dr. McKendrick has conducted the entire work connected with the Chair, in the absence of Prof. Bennett from ill health.

THE government of New South Wales have generously granted 1,000*l*. for the purpose of observing the transit of Venus, and Mr. Russell is taking active measures to provide three stations in that colony with all the requisites for observing the transit, and obtaining at the same time photographs of the planet's position. The three stations will be at Sydney, at Eden, near the south-eastern point of N.S.W., and the third station on the Blue mountains, about fifty miles west from Sydney. Both stations are on telegraph lines, which will be used to determine their longitude. The mountain station has been chosen to avoid, if possible, any chance of cloudy weather, and in the hope that atmospheric difficulties generally will be less.

WE hear with great regret of the death of Dr. Torrey, which took place from pneumonia on March 10. Since the decease of Prof. Darlington he had been the Nestor of American botanists. Torreya, a genus of Taxacea of N. America and N.E. Asia, was named after him. He was a foreign member of the Linnean Society.

THE following has been sent us by a correspondent of M. Riedel:—"The Russian man-of-war *Tsanvina*, Commodore Michel Comancy, is steaming from Ternate to Papua the 28th of November past in search of the missed Russian naturalist, M. Micluha Maclay.—T. G. F. RIEDEL, C.M.Z.S.—Gorontalo, North Celebes, December 30, 187 2."

THE Royal Irish Academy has sanctioned the following grants out of the funds entrusted to it by Parliament for assisting scientific research:—50*l*. to W. H. Bailey for additional explorations at Kiltorcan for fossil plants; 40*l*. to G. H. Kinahan, to assist him in microscopical examinations into the structure of rocks; and 30*l*. to Prof. W. R. M'Nab, M.D., for researches in vegetable physiology.

WE are informed that the Hippopotamus, born a short time ago in the Zoological Gardens at Amsterdam, and which gave some promise of surviving, has, like most of its predecessors, died; so the young "Guy" in Regent's Park, which is doing as well as can be wished, is the only living specimen born and bred in Europe.

PROF. BRÜNNOW, the Astronomer Royal for Ireland, has just issued a second part of his astronomical observations and researches made at Dunsink, the observatory of Trinity College, Dublin. This part contains—New Determination of the Parallax of the Star Groombridge, 1830; Further Investigation of the Parallax of 615 Draconis; Determination of the Parallax of 85 Pegasi; Determination of the Parallax of the * Bradley, 3077; Further Investigations on the Parallax of α Lyræ; Observations of 1830 Groombridge and * (*a*); Observations of 1830 Groombridge, and * (*b*); Observations of 615 Draconis and * (9·5) preceding; Observations of 85 Pegasi; Observations of Bradley 3077 and * (10) following; and Observations of α Lyræ and * (10) following.

THE preliminary report of the U.S. explorations and surveys during the year 1871, in Nevada and Arizona, conducted by Lieut. George M. Wheeler, of the engineer corps, has lately been published in quarto form by the government printer. It contains an account of the plan of the survey, as initiated by Lieut. Wheeler in 1870, and which he has successively continued during the year 1872. The work accomplished during 1871 embraces, among other results, the mapping out of various mining districts, and the determination of the areas, direction, and condition of the lodes. The topographical features of the great Colorado plateau have been developed over the region extending from St. George, in Utah, to the White Mountains near the border line of Arizona and New Mexico, and much information has been gathered as to the geology of this plateau, and of numerous inclosed and interior basins in Nevada. The exploration of the Colorado has determined the absolute limit beyond which a party of examination will not be likely to ascend that river. It has been ascertained that a railroad can cross the Colorado and the mouth of the Virgin River, that it can be carried by easy grades, and that the Colorado can be crossed by a north and south line near the foot of the Grand Cañon.

THE Institution of Naval Architects commences its session for 1873 to-day. The meetings will be held as follows in the hall of the Society of Arts, John Street, Adelphi:—On Thursday, April 3, morning at 12, and evening at 7 o'clock; on Friday, April 4, morning at 12, and evening at 7 o'clock; and on Saturday, April 5, morning at 12 o'clock only. The Right Hon. Sir J. S. Pakington, Bart., M.P., G.C.B., D.C.L., president, will occupy the chair. Judging from the programme of proceedings, this year's meeting ought to be full of interest, and may be productive of important practical results.

THE first report (for 1872) of Governor N. P. Langford, superintendent of the Yellowstone National Park, has just made its appearance, and contains an account of what has been done during the year to protect and preserve this interesting region for the benefit of future visitors. We are informed that new natural wonders are continually discovered, and that the number of geysers, hot springs, &c., is almost countless. The Park was visited during 1872, in connection with the expedition of Prof. Hayden, and new routes determined, by which access will be much easier than heretofore. At present the only mode of approach is by means of saddle and pack trains, and Governor Langford suggests the propriety of constructing several waggon-roads for the convenience of the public. When improvements are made it is thought that extensive settlements will spring up in that region, supported in part by the travel of tourists, and partly by the exportation of lumber made from valuable timber in the district. No mines appear to have been detected, nor is there any prospect of them.

We have received from the U.S. Engineer Office a well-constructed skeleton map prepared by Lieut. Geo. M. Wheeler, Corps of Engineers, U.S. Army, covering that part of the United States west of the 100th meridian, and exhibiting the relations that exist between lines and areas of explorations and surveys conducted under the auspices of the War Department in that region. It is of interest as showing, in an approximately detailed manner, the routes of government surveys over the large area embraced.

An excellent opportunity for obtaining a valuable collection of minerals and fossils is furnished by the offer for sale in the U.S. of the celebrated Troost Cabinet, which, indeed, almost belongs to a former generation, having been packed away since the death of its collector at Nashville, Tennessee, a period of over twenty years. It was brought together at a time when rare and choice minerals were more easily obtained than at pressent, by Dr. Troost, who was at the time state geologist of Tennessee, and succeeded in making up one of the finest series of minerals in this country. The collection is at present in charge of Professor J. B. Lindley, of Nashville, to whom communications on the subject are to be addressed.

The Syndicate recently appointed by the University of Cambridge to inquire into the scheme for establishing a county college at Cambridge have issued their report. While favourable to the scheme generally, they are not prepared to recommend that any special title should at present be offered by the University to students in the manner proposed, or that the University should prescribe rules for the admission of students into the proposed college. They recommend that a general approval be given to the proposed scheme. His Grace the Duke of Devonshire has consented to name the trustees.

The Marquis of Westminster, K G., presided at a meeting at Chester on Saturday, in furtherance of a scheme for uniting under one roof the City Library and Reading Room, the Society of Arts, the Architectural and Archæological Society, the Natural Science Society, and also for establishing a local museum, the nucleus of which is already secured to the city by a valuable and extensive collection of geological specimens presented by the Marquis.

The foundation-stone of the new Presidency College, Calcutta, was laid on February 27 by his Excellency the Governor.

A new archæological society has been started at Rajkote, Kattywar, India, named the Sourashtra Society. Its object is the encouragement of antiquarian research, the recording of traditional and ethnological information, and generally to add to the knowledge of the physical, social, and philosophical condition of the Province of Kattywar.

Probably the oldest collection of specimens of natural history now extant in the United States constitutes a portion of the present cabinet of Princeton College, New Jersey. It was first brought together by Monsieur Delacoste, a French collector and naturalist, who flourished in New York at the beginning of the present century, and who published in 1804 a catalogue of his curiosities (chiefly collected in Guiana), filling a pamphlet of about ninety pages. The collection embraces about 260 species of birds, 63 of quadrupeds (which included both mammals and turtles), over 50 of fishes, and other objects in proportion. This collection is still preserved, for the greater part in good condition, at Princeton. The establishment of the Delacoste collection does not antedate that of Peale in Philadelphia; but that long since disappeared, partly by the scattering of the material collected, and partly from its destruction by fire.

Commander Selfridge arrived at Panama on January 21 last, and sailed on the 25th, on board the steamer *Tuscarora*, for the coast of Darien, for the purpose of continuing the survey of the Darien Ship-Canal route. Work will be commenced about latitude 6° 32′ north and be carried across the "divide," following the valley of the river Bajaya, a tributary of the Atrato, to its junction with the latter river, at a distance of about 150 miles from the Caribbean Sea.

Messrs. Blackwood and Sons have sent us a well-constructed North Polar Chart, by Mr. Keith Johnston. Besides showing the latest discoveries of voyagers within the Arctic circle, the chart indicates each of the farthest points which have as yet been attained on the margin of the unvisited area, the great glacier and snow fields, the average and extreme limits of the appearance of sea ice, the northmost limits of tree growth on the land, the depths of the Arctic waters, so far as these are known, and the elevation of the land which surrounds them. The political boundaries of the countries which come within the limits of the map are also indicated.

We have received a copy of the correspondence between the Royal Geographical Society and the Government with reference to the new Arctic Expedition which Government was unsuccessfully petitioned to undertake. The pamphlet contains *in extenso* all the documents submitted to Messrs. Lowe and Goschen, containing information of great intrinsic value.

The earthquakes in Samos continued in March. A report had been spread by the Smyrniotes that the statement of earthquakes had been invented in the island to draw the Bey back from Constantinople.

On Feb 20 no less than 20 distinct shocks were felt at Afioom Kara Hissar in Asia Minor, causing great alarm, as there was also almost incessant moving of the earth's surface. On the next day the wind veered round to the north with sharp cold and frost.

On March 7, at 6 A.M., a smart shock of earthquake was felt at Rhodes.

Our neighbours on the other side of the Atlantic are continually sending us what they term "Preliminary Descriptions" of novel forms of existing or extinct animals. These consist of new names, followed by short and very imperfect accounts of any apparently peculiar specimens which the author has had the good fortune to hit upon, a note being generally appended to the effect that fuller descriptions will shortly appear in some work now in hand. Our friends seem to forget that the form of ability which gives rise to an illustrious name, is gained by the employment of original method, rather than by the simple recording of novel facts. We fear that the large amount of undigested matter thus brought forward may in the long run produce a condition of dyspepsia of the scientific mind, which will tell hard on the more modest and painstaking workers on the subject, by producing a generally diffused and excessive scepticism as to the value of new discoveries, however promising.

The "Results of Meteorological and Magnetical Observations, 1872," taken at Stonyhurst College Observatory, show that the meteorological work there is done with great care and minuteness.

We would recommend to all science teachers the lecture recently delivered by Mr. Joseph Payne at the College of Preceptors, on "The True Foundation of Science-Teaching," now published in a separate form.

The additions to the Zoological Society's Gardens during the past week include two Barbary Turtle Doves (*Turtur risorius*) from Africa, presented by Mr. G. Hanney; a Yellow-footed Rock Kangaroo (*Petrogale xanthopus*), and a Prince Alfred's Deer (*Cervus alfredi*), born in the Gardens; also a White-thighed Colobus (*Colobus bicolor*) from West Africa, purchased.

*THE THEORY OF EVOLUTION IN GERMANY**

II.

WE must now examine how the primitive organisms have originated, or rather the single primordial organism from which all others have issued. Lamarck has attempted to solve the problem by his hypothesis of *archigony* or primitive being. Darwin avoids touching this question, doubtless to leave a last refuge for the hypothesis of a creation, and to make a final concession to the spiritualist systems. Haeckel shows no such caution; he is willing neither to renounce the scientific explanation of the phenomenon, nor to abandon the ground of natural philosophy to go astray upon that of faith or poetry; before resigning himself to the incomprehensible, he proceeds to explain, by a mechanical hypothesis, the primordial production of life.

He admits first, as to the origin of the earth, the system of Laplace, of whom Kant, about 1755, was the precursor, in his "Theory of the Heavens." This system is in harmony with all the phenomena at present known, and has not been found to disagree in any single instance. Moreover, it has the advantage of being purely mechanical, and of not requiring a resort to any supernatural force. This theory, consequently, plays the same part in cosmogony, and especially in geology, that the theory of Lamarck does in biology, and especially in anthropology. Both are founded exclusively upon efficient, and not upon final and intelligent causes. Both fulfil the conditions of a scientific theory, and have the same title to universal adoption, until the time when even better hypotheses shall be discovered. Haeckel, however, acknowledges that the theory of Kant and Laplace has a feeble foundation upon two points which it cannot explain—the heat to which is due the gaseous mass which formed the primitive world, and the rotatory movement impressed upon that mass. But every attempt to explain these facts leads us inevitably to the untenable theory of an absolute beginning.

We can no more conceive an absolute beginning for the eternal phenomena of movement than we can imagine an absolute end. The universe is, in the order of space and time, immense and without limits. It is eternal and it is infinite. The great law of the conservation of energy, which has become the basis of all our views of nature, does not allow of any other conception. The world, so far as it is accessible to our knowing faculties, appears to us as an uninterrupted chain of movements which determine a continual change of forms; each form is only the transitory result of a sum of phenomena of motion; but under this change of forms, force remains eternally indestructible.

Life could not commence before the earth had cooled sufficiently to allow the water, which had hitherto been in a state of vapour, to become liquefied and to be deposited on the surface; for all animals and all plants, all organisms in short, consist for the most part only of water combined in a particular manner with other materials. But how is it possible to conceive the commencement of organic life? In answer to this question, Haeckel examines first the relations which exist between organisms and the inorganic kingdom, from the standpoint successively of chemistry, of form, and of motion.

Chemistry teaches us that there does not enter into the material composition of living beings, absolutely any substance, which is not found in inanimate nature. There does not exist any distinct organic matter. The differences which exist between organic beings and the inorganic world cannot then have their essential foundation in the different nature of the substances of which they are composed, but only in the processes by which these substances enter into combination. A greater or less density suffices to place a chasm between two groups of bodies; moreover, the degree of density does not depend upon the component elements, but solely upon the temperature: by heating sufficiently a solid body, we can make it pass first into the liquid, and then into the gaseous state. In contrast to these three degrees of density of inorganic bodies, the solid, the liquid, and the gaseous, Haeckel attributes to living beings a fourth state of aggregation which is proper to them, is neither solid like stone, nor liquid like water, but appears to be a mean between the two, and consists always in a characteristic combination of water with organic matter. This mixed state, which is of the highest importance in the mechanical explanation of the phenomena of life, is explained in its turn, according to Haeckel, by the physical and chemical properties of a simple substance, viz. carbon. This element has a peculiar tendency to form with other elements, in the most diverse proportions of number and weight, complicated and very various combinations. Above all it enters into combination with three other elements, oxygen, hydrogen, and nitrogen, in order to form the indispensable base of all vital phenomena, viz. albumen or protein. Certain very simple organisms, such as the monads, are only small masses of semi-liquid, semi-solid albumen; and it is the same for the most part with other organisms in the earliest stages of their development, when they are as yet only simple cells; albumen then takes the name of *plasma* or protoplasm, and this plasma is now considered as the starting-point of all vital phenomena. Thus it is not more difficult for us to give a general explanation of life than it is to explain the physical properties of inorganic bodies. It is true that ultimate causes are hidden from us; but it is the same in the inorganic world. If we are unable to say why such a combination engenders a cell, no more can we understand why gold crystallises into a tetrahedric or antimony into a hexagonal form. Thus, from a chemical point of view, it impossible to establish any difference between the organic and inorganic kingdoms.

Again, with respect to Form, the simple and homogeneous structure of crystals is opposed to the heterogeneous and complicated structure of living beings; but certain inferior organisms, such as the monads, are formed solely of a small albuminous mass of a structure as simple as that of a piece of silex. Animals and plants thus appear, at first sight, not to have any mathematically determined form like crystals; but Haeckel has pointed out among the *Radiolaria* and many other protozoa a great number of inferior organisms, which, like crystals, may be referred to regular geometrical forms. He has also, in his "General Morphology" (pp. 375—574), presented an ideal system of stereometric forms which explain both the actual forms of inorganic crystals, and those of organic individuals. There is finally a large number of living beings completely amorphous, such as the monads, the *amœbæ*, &c., whose shape is constantly changing, and in which it is as impossible to recognise a determinate form as it is in the case of amorphous inorganic beings, such as non-crystallised stones, precipitates, &c. In respect of form, then, there is no more essential difference between organic and inorganic beings.

Let us now consider Movement. At the present day, as the hypothesis of a vital force is completely abandoned, it is necessary, according to Haeckel, to refer all manifestations of life, and particularly the phenomena of nutrition and reproduction, to the properties of carbon, or at least of hydrogen. With regard to growth, the only difference between living beings and inorganic bodies lies in this, that the former grow in size by intersusception, that is, by the introduction of new particles into their interior, while the latter are enlarged by opposition, by the external addition of new matter. The external conformation is determined, in crystals as well as in organisms, by the laws of adaptation; the form and the size of the crystal depends on the circumstances in which it is placed, on the vessel in which the process of crystallisation goes on, on temperature, on atmospheric pressure, on the presence or absence of foreign bodies. The form of every crystal, as well as the form of every organism, is thus the result of the struggle between two factors,—an internal plastic force proceeding from the chemical constitution of the body, and an external plastic force the result of the influence of the medium. Consequently, if growth and form are processes of life, there is no reason for refusing to attribute life to the inorganic world, as well as to organisms.

As soon as this unity of organic and inorganic nature is fairly established, the problem of primordial or spontaneous generation presents much fewer difficulties. If the attempts which up to the present time have been made to bring about experimentally spontaneous generation have not led to positive results, the only inference to be drawn is, that we are as yet ignorant of the conditions in which it takes place, conditions which, moreover, we may perhaps not now be able to reproduce. It is evident that all the matter which has become organic, would, at the time when the earth was not sufficiently cooled, be mixed in the atmosphere in a form of which we are ignorant. How are we able to reproduce completely in our laboratories all the chemical, electric, and other conditions of that primitive atmosphere? Meanwhile, the combinations of carbon which have already been obtained artificially, give ground for hoping that ere long we shall be able to reproduce the most important of all, the matter of the *plasma* or albumen.

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* Continued from p. 352.

But the most powerful arguments in favour of spontaneous generation are furnished by the study of the monads, the simplest of all organisms, which Haeckel has made the subject of a special monograph. Seven species of these are known, some of which live in fresh water, and some in the sea, all of them consisting of small formless masses of albuminous combinations of carbon, and differing from each other only in their mode of reproduction, development, and nutrition. As these living beings do not present any complication of diverse parts, any division of functions or of organs, as all the phenomena of life with them proceed in a homogeneous manner, and without determinate form, it is very easy to conceive of their spontaneous generation. There is indeed one species which even at the present day appears to be born spontaneously, it is that which has been discovered by Huxley, and which has been described under the name of *Bathybius Haeckelii.* It inhabits the sea at depths of from 12,000 to 24,000 feet; it covers the ground sometimes as a network of strings of *plasma*, and sometimes in little heaps. The nucleus of it seems to be formed by a local condensation of albuminous matter, and the monad becomes a cell. As we have seen above that all animals and plants have their starting-point in a cell, it is allowable to suppose that all species are only monads gradually modified by natural selection.

It will be seen that all the views of Haeckel are founded upon the cellular theory as it has been formulated by Schleiden and Schwann. Haeckel always distinguishes two elements—*cytodes* and cells properly so called, reuniting these two elements under the generic name of *plastides.* Cytodes are parcels of plasma destitute of a nucleus, while cells are plastides endowed with a nucleus; each of these two species being subdivided in its turn into two groups, according as they are or are not enveloped by an exterior membrane. Hence there are four forms of *plastides*: (1) Naked or primitive cytodes, like the present existing monads, the only ones which can proceed directly from spontaneous generation; (2) Cytodes with membranes (*lepocytoda*), proceeding from naked cytodes by a coagulation of the exterior portion of the plasma; (3) Naked or primitive cellules by coagulation of an interior portion of the plasma; and (4), Membranous cells, proceeding either from membranous cytodes by interior condensation of the nucleus, or from naked cells by the external formation of a membrane.

There are two theories, one of which may be adopted. Either the monads at present known are descended by propagation from primitive monads and have preserved the same form for millions of years; or, even at this present time, as was the case in the earlier days of organisation, they owe their existence to repeated acts of spontaneous generation. The latter hypothesis is in no respect less probable than the former.

(*To be continued.*)

SCIENTIFIC SERIALS

Journal de Physique Théorique et Appliquée. Par J-Ch. d'Almeida, Prof. de Physique au Lycée Corneille, Paris. We have before us the numbers of the "Journal de Physique théorique et appliquée" extending over the first year of its existence. The object of the journal, which consists of monthly parts of about forty pages each, is stated in the preface to the first number (January 1872) to be the giving of a new impulse to the study of physical science. This its authors aim at doing "by unfolding the more recent and less known theories, by describing the experiments upon which they rest, by indicating the most easy means of repeating them, and by narrating the progress which physical science makes day by day in France and other countries." By the execution of this project "they hope to interest everyone who is acquainted with the principles of science, to enliven teaching, to excite the spirit of research, and to stimulate discoveries." The journal, which is principally mathematical in its treatment of the subjects, differs considerably from such a journal as the "Philosophical Magazine." The original articles in it are few and unimportant. There are criticisms on and reprints of articles selected from other journals, and bearing on the subjects to which this is devoted; but the distinguishing feature of the journal consists in articles, continued generally through several successive numbers, reproducing and elucidating important theories and investigations, which are thus presented in an easily accessible form. Thus the first number starts off with an article on "Electrostatic measures." We also have a series of articles by M. Terquem on electricity and magnetism, beginning in No. 1 with a short article stating the experiments by which it is demonstrated that free electricity resides only in the surfaces of conductors, and then proceeding in No. 2, and subsequent numbers, to treat of the various units employed in measuring quantities of electricity and magnetism, and the relations which exist between them. The reader will gather the character of such articles as those to which we refer, from the following enumeration of the titles of a few others of those which are more important:—"On the action of a magnet on a magnetised molecule at a distance," "On the analogy between the propagation of heat and the distribution of electricity," "On the propagation of permanent electric currents," "On the employment of the wave theory in optical calculations," "On Electrodynamics and the theory of induction." These articles do not contain original matter, nor for the most part do they contain matter arranged in an original way, but they contain useful and concise expositions of the subjects, reproducing such points as the proof of Ampère's theory, Ohm's laws, the method of comparing electro-magnetic and electro-static units, and the like. Such articles will be principally useful to those who cannot obtain the original investigations, or who desire to avoid the labour of consulting those manuals in which these investigations may be included. The journal seems certainly well calculated to extend a knowledge of and interest in the subjects with which it deals, and thus to assist in achieving the end which it proposes to itself.

JAMES STUART

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 20.—"On the Temperature at which *Bacteria, Vibriones*, and their Supposed Germs are killed when immersed in Fluids or exposed to Heat in a Moist State." By H. Charlton Bastian, M.D., F.R.S., Professor of Pathological Anatomy in University College, London. (*Continued from p.* 413.)

The facts just cited concerning the behaviour of thin films of turbid infusions which had been heated to different temperatures gave me the clue as to the proper direction of future work. It would seem that when mounted in the manner described, such thin films of infusion continue capable of supporting and favouring the multiplication of any already existing *Bacteria* and *Vibriones*, although, under such conditions, no new birth of living particles appears to take place even in these fluids. The question then arose as to whether, by subjecting larger quantities of the same infusions to any particular sets of conditions, we could ensure that they also should continue to manifest the same properties. Because if so, it would be almost as easy to determine the death-point of *Bacteria* and *Vibriones* when exposed to heat in these infusions, as it had been to determine it for the saline solutions already mentioned.

It was pointed out by Gruithuisen early in the present century that many infusions, otherwise very productive, ceased to be so when they were poured into a glass vessel whilst boiling, and when this was filled, so that the tightly-fitting stopper touched the fluid. Having myself proved the truth of this assertion for hay-infusion, it seemed likely that, by having recourse to a method of this kind, I should be able to lower the virtues of boiled hay and turnip infusions to the level of those possessed by the boiled saline solution with which I had previously experimented—that is, to reduce them to a state in which, whilst they appear quite unable of themselves to engender *Bacteria* or *Vibriones*, they continue well capable of favouring the rapid multiplication of such organisms.

This was found to be the case, and I have accordingly performed upwards of one hundred experiments with inoculated portions of these two infusions raised to different temperatures. The mode in which the experiments were conducted was as follows:—

Infusions of hay and turnip of slightly different strengths were employed. These infusions having been first loosely strained through muslin, were boiled for about ten or fifteen minutes, and then whilst boiling strained through ordinary Swedish filtering-paper into a glass beaker which had previously been well rinsed with boiling water. A number of glass bottles or tubes were also prepared, which, together with their stoppers or corks, had been boiled in ordinary tap water for a few minutes.* They were taken out full of the boiling fluid; and the stoppers or corks being at once inserted, the vessels and their contents were set aside to cool. When the filtered infusion of hay or turnip had been rapidly cooled down to about 110° F. (by letting the beaker containing it stand in a large basin of cold water), it was inoculated with some of a turbid infusion of hay swarming with active *Bacteria* and *Vibriones*—in the proportion of one drop of the turbid fluid to each fluid ounce of the now clear filtered infusion[*]. The beaker was then placed upon a sand-bath, and its contained fluid (in which a thermometer was immersed) gradually raised to the required temperature. The fluid was maintained at the same temperature for five minutes by alternately raising the beaker from and replacing it upon the sand-bath. The bottles to be used were then one by one uncorked, emptied, and refilled to the brim with the heated, inoculated fluid.[†] The corks or stoppers were at once very tightly pressed down so as to leave no air between them and the surface of the fluids. The beaker was then replaced upon the sand-bath and the gas turned on more fully, in order that the experimental fluid might be rapidly raised to a temperature 9° F. (5° C.) higher than it had been before. After five minutes' exposure to this temperature other bottles were filled in the same manner, and so on for the various temperatures the influence of which it was desired to test.

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* The vessels employed have varied in capacity from two drachms to four ounces; some have been provided with glass stoppers and others with very

Thus prepared, the bottles and tubes have been exposed during the day to a temperature ranging from 65° to 75° F. And generally one had not to wait long in order to ascertain what the results were to be. In some cases, if the contents of the vessels were to become turbid, this was more or less manifest after an interval of forty-eight hours. In other cases, however, the turbidity manifested itself three or more days later, and the reason of this difference will be fully discussed in a subsequent communication.

For the sake of simplicity and brevity, the necessary particulars concerning the 102 experiments have been embodied in the table which will be found below.

The experimental results here tabulated seem naturally divisible into three groups. Thus, when heated only to 131° F., all the infusions became turbid within two days, just as the inoculated saline solutions had done.[‡] Heated to 158° F. all the inoculated organic infusions remained clear, as had been the case with the saline solutions in my previous experiments, when heated to 140° F. There remains, therefore, an intermediate heat zone (ranging from a little below 140° to a little below 158° F.), after an exposure to which the inoculated organic infusions are apt to become more slowly turbid, although inoculated saline solutions raised to the same temperatures invariably remain unaltered. The full explanation of these apparent anomalies I propose to make the subject of a future communication to the Royal Society; meanwhile we may quite safely conclude that *Bacteria*, *Vibriones*, and their supposed germs are either actually killed or else completely deprived of their powers of multiplication after a brief exposure to the temperature of 158° F. (70° C.).

This evidence now in our possession as to the limits of "vital resistance" to heat displayed by *Bacteria*, *Vibriones*, and their supposed germs in neutral saline solutions, and in neutral or acid organic infusions, is most pertinent and valuable when considered in relation to that supplied by other sets of experiments bearing upon the all-important problem of the Origin of Life. These latter experiments alone may possibly leave doubt in many minds; but the more thoroughly they are considered in relation to the evidence brought forward in this communication, the more fully, I venture to think, will every lingering doubt as to the proper conclusion to be arrived at be dispelled.

Thus, we now know that boiled turnip- or hay-infusions exposed to ordinary air, exposed to filtered air, to calcined air, or shut off altogether from contact with air, are more or less prone to swarm with *Bacteria* and *Vibriones* in the course of from two to six days. But, placed under slightly different conditions such as were employed in the inoculation experiments above quoted, although infusions of the same nature do not undergo "spontaneous" putrefactive changes, yet when living *Bacteria* and *Vibriones* are added and not subsequently heated, putrefaction *invariably* takes place and the fluids thus situated rapidly become turbid. There is therefore nothing in the conditions themselves tending to hinder the process of putrefaction, so long as living units are there to initiate it. Our experiments now show that as long as the added *Bacteria*, *Vibriones*, and there supposed germs are subjected to a heat not exceeding 131° F. (55° C.), putrefaction invariably occurs within two days, whilst, on the contrary, whenever they are subjected to a temperature of 158° F. (70° C.) putrefaction does not occur. To what can this difference be due, except to the fact that the previously living organisms which, when living, always excite putrefaction, have been killed by the temperature of 158° F.? It would be of no avail to suppose that the absence of putrefaction in these latter cases is due to the fact that a heat of 158° F., instead of killing the organisms and their germs, merely annuls their powers of reproduction, because in the other series of experiments (with which these have to be compared) where similar fluids are exposed to ordinary or purified air, or are shut off from the influence of air altogether, the most active putrefaction and multiplication of organisms takes place in two, three, or four days, in spite of the much more potent heat of 212° F., to which any pre-existing germs or organisms must have been subjected. The supposition, therefore, that the *Bacteria*, *Vibriones*, and their germs were not killed in our inoculation experiments at the temperature of 158° F., but were merely deprived of their powers of reproduction, would be no gain to those who desire to stave off the admission that *Bacteria* and *Vibrones* can be proved to arise *de novo* in certain cases. Let us assume this—which is indisputably proved by these inoculation experiments—viz. that an exposure to a temperature of 158° F. (70° C.) for five minutes deprives *Bacteria*, *Vibriones*, and their germs of their usual powers of growth and reproduction—that is that it reduces them to a state of potential, if not necessarily to one of actual death. What end would be served by such a reservation? The impending conclusion would not be staved off by means of it. The explanation of what occurs in the other set of experiments, where the much more potent heat of 212° F. is employed, still would not be possible without having recourse to the supposition of a *de novo* origination of living units, so long as those which may have pre-existed in the flask could be proved to have been reduced to such a state of potential death. It would be preposterous, and contrary to the whole order of nature, to assume that the vastly increased destructive influence of a heat of 212° F. had restored vital properties which a lesser amount (158° F.) of the same influence had completely annulled.

The evidence supplied by these different series of experiments in whichever way it is regarded, as it seems to me, absolutely compels the logical reasoner to conclude that the swarms of living organisms which so often make their appearance in boiled infusions treated in one or other of the various modes already proved to be either destructive or exclusive of pre-existing living things, are the products of a new brood of "living particles," which, in the absence of any co-existing living organisms, must have taken origin in the fluid itself. For this mode of origin of living units, so long spoken of and repudiated as "spontaneous generation," I have proposed the new term Archebiosis.

Inoculation Experiments made with the view of ascertaining the Temperatures at which Bacteria, Vibriones, *and their Supposed Germs are killed in Organic Infusions.*

NEUTRAL HAY INFUSION.

Temp. to which exposed.	Number of Experiments made.	Date of Turbidity, if any.	Results at Expiration of the 8th day.
122° F. (50° C.)	1	24 hours	Turbid.
131° F.	7	48 hours	All turbid.
140° F.	9	1 in 48 hours 6 in 60 hours 1 in 3 days 1 in 8 days	All turbid.
149° F.	4	2 in 5 days 1 in 8 days	Three turbid. One clear.
158° F.	15	... ...	All clear.
167° F.	4	... ...	All clear.
176° F. (80° C.)	12	... ...	All clear.

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tightly fitting corks; and the latter I find have answered quite as well as the former. On the whole I have found tightly corked 1 oz. phials to be about the most convenient vessels to employ in these inoculation experiments.

[*] It was found desirable to filter the infusions after they had been boiled, because the boiling generally somewhat impaired their clearness.

[†] At this stage, of course, *very great care* is needed in order to avoid all chance of accidental contamination either with living organisms or with unheated fragments or particles of organic matter.

[‡] In the experiments already referred to.

ACID TURNIP INFUSION.

Temp. to which exposed.	Number of Experiments made.	Date of Turbidity, if any.	Results at Expiration of the 8th day.
122° F.	...	... ...	... ...
131° F.	7	5 in 24 hours 2 in 48 hours	All turbid.
140° F.	12	6 in 40 hours 4 in 3 days 2 in 4 days	All turbid.
149° F.	10	1 in 3 days 3 in 5 days 1 in 7 days 2 in 8 days	Seven turbid. Three clear.
158° F.	17	... ..	All clear.
167° F.	4	... ...	All clear.
176° F.	...	... ...	... ...

March 27.—"On the Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and its variation in amount with her Phases." By the Earl of Rosse, D.C.L., F.R.S.

In this paper is given an account of a series of observations made in the Observatory of Birr Castle, in further prosecution of a shorter and less carefully conducted investigation, as regards many details, which forms the subject of two former communications* to the Royal Society. The observations were first corrected for change of the moon's distance from the place of observation, and change of phase during the continuance of each night's work, and thus a curve, whose ordinates represented the scale-readings (corrected) and whose abscissæ represented the corresponding altitudes, was obtained for each night's work. By combining all these, a single curve and table for reducing all the observations to the same zenith-distance was obtained, which proved to be nearly, but not quite, the same as that found by Professor Seidel for the light of the stars. By employing the table thus deduced, and also reducing the heat-determinations obtained on the various nights for change of distance of the sun, a more accurate phase-curve was deduced, indicating a more rapid increase of the radiant heat on approaching full moon than was given by the formula previously employed, but still not so much as Prof. Zöllner's gives for the moon's light.

By employing Laplace's formula for the extinction of light in our atmosphere, the heat-effect in terms of the scale-readings was deduced, and an approximation to the height of the atmosphere attempted.

From a series of simultaneous measurements of the moon's heat and light at intervals during the partial eclipse of November 14, 1872, when clouds did not interfere, it was found that the heat and light diminish nearly if not quite proportionally; the minimum for both occurring at or very near the middle of the eclipse, when they were reduced to about half their amounts before and after contact with the penumbra.

PARIS

Academy of Sciences, March 24.—M. de Quatrefages, president, in the chair. M. Faye read a long and exhaustive reply to M. Vicaire's criticisms on his solar theory and attempted revival of Wilson's hypothesis. He answered each objection in detail, and maintained that his position had not been affected by M. Vicaire's arguments.—M. Berthelot read a paper on the constitution of the solutions of the hydracids, and on their inverse reactions. He believes that the increase of heat evolved with increased dilution proves the existence of a number of hydrates, and that the quantity of hydrated acid required to precipitate certain chlorides from their solutions will throw more light on this point.—On certain propyl new derivatives, related to the metallic propyl compounds, by M. A. Cahours.—M. Th. Lestibondois read a note on certain anomalous lianas.—Papers were read on the conditions under which certain periods of the quadratics of a curve of *m* degrees disappear or become infinite, by M. Max Marie.—On a new double-image micrometer, by M. C. Noel.—On the measurement of the chemical effect of solar light, by M. E. Marchand.—On Phylloxera, &c., by M. L. Faucon.—On a new method of determining the position of the nodal surfaces in masses of vibrating gas, by M. D. Gernez.—On the volumetric estimation of carbonic anhydride, by M. Houzeau. The author has devised a method for the application of volumetric analysis to the determination of CO_2 in agricultural chemistry. The process consists in absorbing the gas in soda solution containing zincic oxide, precipitating the carbonate formed with neutral solution of baric chloride, and titrating the free soda left with standard sulphuric acid.—Researches on trichloracetic acid and the trichloracetates, by M. A. Clermont.—On the bursting of the skin of fruits exposed to persistent rain, &c., by M. Joseph Boussingault. The author finds that this is due to the diffusion of water into the fruit. Many kinds of fruit thus absorb large quantities of water, and ultimately burst. The author has also experimented on leaves and stalks. In every case sugar diffused out of the fruit and leaves.—On the snow-line, and its elevation in different parts of the world, by M. Ch. Grad.—On M. Pasteur's process for silk-worm preservation, by M. Guisquet, was an answer to M. Guérin-Méneville, who has denied M. Pasteur's statements.—On the phenomena of hibernation presented by flies exposed to successive changes of heat and cold in Russia, by M. Goubareff. Flies found perfectly torpid became lively at + 33° Réaumur, and became again torpid when the temperature was allowed to fall.—On an optical phenomenon produced by the condensation of dew on grass, by M. J. Leterme.

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* Proceedings of the Royal Society, vol. xvii. p. 436; xix. p.

DIARY

THURSDAY, APRIL 3.

ROYAL SOCIETY, at 8.30.—On the Structure of Striped Muscular Fibre: E. A. Schafer.—Note on the Synthesis of Marsh Gas, and the Electric Decomposition of Carbonic Oxide: Sir B. C. Brodie.—On an Air Battery: Dr. Gladstone and A. Tribe.

SOCIETY OF ANTIQUARIES, at 8.30.—Greek Liturgies and Byzantine Architecture: Edwin Freshfield.

CHEMICAL SOCIETY, at 8.—A way of exactly determining the specific gravity of Liquids: Dr. H. Sprengel.—On Cymene from various sources: Dr. C. R. A. Wright.—Researches on the action of the Copper-zinc couple on organic bodies, II.—On the iodides of Amyl and Methyl: J. H. Gladstone and A. Tribe.—Contributions from the Laboratory of the London Institution, No. XI.—Action of the acid chlorides on Nitrates and Nitrites: Dr. H. G. Armstrong.

LINNEAN SOCIETY, at 8.—On new Indian Fishes: Surgeon-Major F. Day.—On the Fungi of Ceylon: Rev. M. J. Berkeley and C. E. Broome.

ROYAL INSTITUTION, at 3.—Coal and its Products: A. V. Harcourt.

FRIDAY, APRIL 4.

ROYAL INSTITUTION, at 9.—Observations on Niagara: Prof. Tyndall.

GEOLOGISTS' ASSOCIATION, at 8.—The Diamond Fields of South Africa: G. C. Cooper.—On some Fossils from the Margate Chalk: J. W. Wetherell.

ARCHÆOLOGICAL INSTITUTION, at 4.

SATURDAY, APRIL 5.

ROYAL INSTITUTION, at 3.—Darwin's Philosophy of Language: Prof. Max Müller.

SUNDAY, APRIL 6.

SUNDAY LECTURE SOCIETY, at 4.—The Stereoscope, the Pseudoscope, and Binocular Vision: W. B. Carpenter.

MONDAY, APRIL 7.

ENTOMOLOGICAL SOCIETY, at 7.

LONDON INSTITUTION, at 4.—Elementary Botany: Prof. Bentley.

VICTORIA INSTITUTE, at 8.—Force: Prof. Kirk.

WEDNESDAY, APRIL 9.

PHOTOGRAPHIC SOCIETY, at 8.

GEOLOGICAL SOCIETY, at 8.—Lakes of the North-eastern Alps, and their bearing on the Glacier-erosion theory: Rev. T. G. Bonney.—Notes on Structure in the Chalk of the Yorkshire Wolds: J. R. Mortimer.

LONDON INSTITUTION, at 7.—Paper and Discussion.

ARCHÆOLOGICAL ASSOCIATION, at 8.

ASTRONOMICAL SOCIETY, at 8.

SOCIETY OF TELEGRAPH ENGINEERS, at 7.30.—On a Bell Alarm for Submarine Cables: Wm. F. King.—On the Measurement of Battery Resistance: Jas. Graves.—On the Mechanical Tests of Iron Wire: R. S. Culley.

THURSDAY, APRIL 10.

MATHEMATICAL SOCIETY, at 8.—On Systems of Porismatic Equations, Algebraical and Trigonometrical; Note on Epicycloids and Hypocycloids; Locus of point of concourse of perpendicular Tangents to a Cardioid; Elliptic motion under acceleration constant in direction: Prof. Wolstenholme.—On the calculation of the Value of the theoretical unit-angle to a great number of decimal places: Mr. J. W. L. Glaisher.

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THURSDAY, APRIL 10, 1873

INSTINCT

THE very valuable contribution to Psychology made by Mr. Spalding in his paper on Instinct (*Macmillan's Magazine* for February), and the letters and article which have lately appeared in this Journal, will no doubt stimulate research, and lead to some rational explanation of what has hitherto been enveloped in a mist of metaphysics. Mr. Spalding has not only proved himself an acute thinker, he has shown a rare ability in devising experiments, and we may fairly expect that his researches will mark an epoch. I am the more grateful to him because his instructive results, though seeming to contradict, do really furnish experimental confirmation of the views put forth in my work, now in the press, wherein it is argued that Instinct is *lapsed* Intelligence: that what is now the fixed and fatal action of the organism, was formerly a tentative and discriminating (consequently intelligent) action: in a word that what is now a connate tendency was formerly acquired experience.

There is great need of precise definition of terms. What is Instinct? What is Experience? What is Intelligence? Twenty different writers indicate twenty different things by these terms. They do not distinguish between Instinct and Impulse; between Experience acquired by the individual, and Experience transmitted from ancestors; between Intelligence, the discernment of Likeness and Unlikeness in feelings, and Intellect, the discernment of Likeness and Unlikeness in symbols. Above all they seldom make clear whether they are treating any fact from the psycho*logical* or from the psycho*genetical* point of view, *i.e.* whether they are describing the Anatomy or the Morphology of the Mind. It is, for instance, one thing to affirm that our perception of Space is a perception necessarily conditioned by our organism, and in that sense *à priori*; another thing to affirm that this conditioned structure is itself the evolved result of ancestral experiences of Sight, Touch, and Motion, and in that sense the perception of space is *à posteriori*. The point of difference between the empirical and nativistic schools may be got rid of by such a precision in the question. The vital point will then be between the advocates of evolution and the advocates of creation. Those who hold that the Organism is evolved, must hold that its perceptions (and instincts) are evolved through Experience. Those who hold that the Organism is created, and was from the first what we see it now, must hold that its perceptions (and instincts) are pre-ordained, and have no experiential origin whatever.

Having thus cleared the ground of a mass of obstruction, we may now approach the subject of Instinct. In what sense can it be said to be dependent on Experience? Obviously this cannot be answered till we are agreed on the meaning to be assigned to the term Experience. I have defined it the *registration* of Feeling. And what is Feeling? It is reaction of the sentient Organism under stimulus. This reaction has obviously two factors: the structure of the organism, and the nature of the stimulus. It is not every response of the organ that can be a feeling, it is not every feeling that can be an experience. The secretion of a gland is a response, physiologically similar to the response of a sensory organ; but the former is not a feeling, although it enters as an element into the mass of Systemic sensation; and the response of a sensory organ, although a feeling, will not be an experience unless it be *revivable;* and this revival requires that it should be *registered* in the modification impressed on the sentient structure. It is true that rigorously speaking no body, not even an inorganic body, can be acted on without being modified; every sunbeam that beats against the wall *alters* the structure of that wall; but these minute alterations are not only inappreciable for the most part, by any means in our power, they are also mostly annulled by subsequent alterations. In one sense, therefore, no impression ever excites Feeling without modifying the sentient structure; but some impressions, especially when iterated, produce definite and permanent modifications; and these are registrations capable of revival, *i.e.* of the feelings registered, so that when the organism is stimulated its reaction will be determined by those past reactions, and the product will be a feeling more or less resembling the feelings which were formerly produced. Thus we have Feeling as the reaction of the Organism; and the Organism itself as a structure which has been modified by its reactions on external stimuli. What the structure of the Organism is at any stage determines what will be the kind of sentient reactions it will have. Experience is the registration of Feeling, registered in those modifications, which, because they are modifications of structure, must have corresponding activities of Feeling, and from these spring Actions. To trace the history of these modifications or their feelings is Morphology or Psychogeny; to describe their results is Anatomy or Psychology.

We cannot be in doubt then whether Instinct is or is not dependent on Experience; we can only ask: Is a particular action characteristic of a particular animal species, one that the animal has itself *learned* to perform through the adaptation of its organs, under the guidance of sensible impressions reviving the past impressions of *its* experience; or an action inevitably determined by the reactions of the structure inherited from ancestors, so that sensible impressions revive ancestral experiences registered in the modifications impressed on the structure? The answer in each case can only be approximative; and for this reason: until the organism has the requisite degree of development for the performance of the actions, there can be no manifestation of the instincts, and there are few of the instincts manifested at birth.

How, then, shall we define Instinct? How separate the actions which are congenitally determined, from those which are incidentally determined? Both require the indispensable conditions of an appropriate structure and appropriate stimuli. It is obvious that we cannot fix upon the structure alone; and yet the congenital tendencies of that structure must be taken into account; for we see instincts not manifested until long after many other actions have been acquired—as in the case of the sexual instinct. But if congenital tendencies sufficed, we should call the flowering of plants at their normal season when transplanted to a *different* climate, an instinct. Many would say that an action common to an entire group of animals must be an instinct, since it could not be acquired through individual experience. But how if the conditions of acquisition are also common to the whole group? Thus an infant certainly learns to scratch itself; since, however it may itch, some considerable experience is necessary before it learns to localise the sensation. As, however, the conditions of this acquisition are common to all children, all learn to scratch themselves. Now in many animals this is an inherited acquisition; they scratch themselves from the first. Whether the infant also inherits a structure which would develop into one as apt as that of the animal, cannot be ascertained; all we know is that the infant's nervous structure is too immature at first to permit the localisation of sensation. How much of the subsequent aptitude is the result of congenital tendency, and how much of acquisition through incidental experiences acting on a predisposed organism, cannot be estimated.*

That we require some character to distinguish the instinctive from the impulsive actions, may be readily shown. No one calls Breathing, Secretion, Excretion, &c., instincts. Yet these are the actions of congenital tendencies in the organism. "A hungry chick," says Mr. Spalding, "that never tasted food, is able on seeing a fly or spider for the first time, to bring into action muscles that never were so exercised before, and to perform a series of delicately adjusted movements that end in the capture of the insect." Every one would pronounce this a typical case of Instinct. Now compare with it the following, which no one would class among the instincts: A new-born animal that has never breathed before is able on first feeling the stimulus of the atmosphere to bring into action a very complicated group of muscles which never were so exercised before, and to perform a series of delicately adjusted movements which end in the aëration and circulation of the blood.

This contrast may lead us to the character sought. Understanding that every line of demarcation in psychical phenomena must be more or less arbitrary, and only justified by its convenience, we may draw such a line between Impulse and Instinct. Impulses are the actions which from the first were fatal, inevitable, being simply the direct reflex of the stimulated organs. Given the respiratory organs and the atmosphere, Respiration is the inevitable result. Given the secretory organ and the plasma, Secretion is the inevitable result. There is no choice, the action either takes place or it does not.

Instincts *are* also fatal, inevitable, but they *were* not always so; the element of choice intervenes; and although the intelligent discrimination may be *almost* entirely lapsed, it never is wholly lapsed. The guiding sensation is still discriminative, selective. Hence instincts vary with varying conditions. Thus the *nutritive impulse* which when unsatisfied causes the uneasiness of desire, and which moves the animal in search of food, is markedly distinguishable from the *instinct* which selects the appropriate food and rejects all the rest. If an animal eats only certain kinds of food, out of many which would be nutritious, it is because these kinds have been selected by it, or by its ancestors. Every chicken, Mr. Spalding assures us, has to learn not to eat its own excrement. "They made this mistake invariably, but they did not repeat it oftener than once or twice." He also has this remark:—"Chickens, as soon as they are able to walk, will follow any moving object; and when guided by sight alone they seem to have no more disposition to follow a hen than to follow a duck or a human being. Unreflecting onlookers when they saw chickens a day old running after me, and older ones following me miles and answering my whistle, imagined that I must have some occult power over the creatures, whereas I simply allowed them to follow me from the first. There is the instinct to follow; and, as we have seen, their ear, prior to experience, attaches them to the right object."

I should rather say, "there is the *impulse to follow*: and the instinct to follow the mother, or a duck, or the master who feeds them, is the selected action which becomes rapidly an organised habit." It is one of the conclusions of my work that all our involuntary and automatic actions, were originally voluntary, and that all instinctive actions were originally intelligent. In the case now under consideration, the impulse to follow is a fixed tendency; the instinct to follow is facultative at first, and becomes fixed by habit, but is always, even when most firmly fixed, guided by discriminating feeling.

To conclude: where there is no alternative open to an action it is impulsive; where there is, or originally was, an alternative, the action is instinctive; where there are alternatives which may still determine the action, and the choice is free, we call the action intelligent.

GEORGE HENRY LEWES

HANDBOOK FOR THE PHYSIOLOGICAL LABORATORY

Handbook for the Physiological Laboratory. By E. Klein, M.D.; J. B. Sanderson, F.R.S.; M. Foster, F.R.S.; and T. L. Brunton, M.D., D.Sc. (Churchill.)

STUDENTS of chemistry have, for a long time, by means of the works of Fresenius and others, had the opportunity, almost unaided, of verifying for themselves most of the experimental results of which they hear in lectures, and read in text-books; and thus many are able, before they have finished their educational course, to obtain a thorough practical knowledge of the science. Such has not been the case with regard to physiology; the subject is less advanced, and has progressed more slowly; perhaps this is because the descriptions of the methods by which the ends have been arrived at, as given by lecturers and writers, are incomplete and insufficient. The work before us is the first important attempt that has been made to put the commencing physiologist in a fair position to begin original work on the subject, by giving him the necessary directions for himself performing many of the fundamental experiments on which the science is based. Whether physiology in its most comprehensive sense, as understood by the authors of this work in their title, is a single branch of science which can be thus treated in its unity, or whether it ought to be divided up and incorporated with others already established, is a point which has not yet been satisfactorily settled, and which the perusal of this book may assist in proving.

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* The examples of dogs and horses finding their way home, however marvellous, cannot be affiliated on Instinct, since it is very far from common to the species: for one dog who finds his way home, hundreds are helpless when lost.

The work is in two volumes, the first, much the larger, being devoted to the text, while the second contains the drawings of the microscopical preparations described, as well as the instruments, diagrams, and dissections referred to.

The histological section, written by Dr. Klein, is, as a whole, far superior to any existing work on the subject, which is saying a great deal, considering the large number of treatises on the use of the microscope, in the study of the tissues of the animal body, which have already appeared. The careful way in which all the many details receive their due consideration, is an example to authors of text-books, and it is rendered evident on every page that the author is himself thoroughly familiar personally with the points he records. Many methods till now comparatively little known and employed in this country are fully discussed, among the most important of which is that of injecting organs by the "method of puncture," introduced by Ludwig, which though it in many cases gives very decided results, has to be used with caution, as their interpretation is often far from easy and sometimes misleading. The minutest details, the omission of which so often mars the results are given in many cases as well as if the teacher himself were by the side of his pupil. The means to be employed for obtaining a view of the stomata of the lymphatic system, as they are seen on the centrum tendineum of the diaphragm, is a case in point to which several pages are devoted, in which also the structure of these little understood organs is excellently entered into. The chapter on embryology is also very complete; the paragraphs on striated muscular fibre are as logical as they are clear, the following being the summary:—"From all these (the previous) facts we learn that the substance of a muscular fibre consists, in the first place, of oblong prisms, *i.e.*, sarcous elements, with their axes parallel to its axes, and formed of a material which refracts light strongly, is stained strongly with silver, slightly with solution of chloride of gold, and swells out in the fresh state on the addition of water; and secondly, of a less refractive transparent interstitial substance occupying the remainder of the space, which is not coloured by silver, but is intensely stained by chloride of gold, and disappears in dilute acetic acid." The illustrations accompanying the descriptions are new, and on a sufficiently large scale to render quite apparent the minutest structural points; much may be learnt from a simple inspection of them. We do not quite like the introduction of so many German synonyms for many of the terms employed, they convey but little meaning to most English students, and though otherwise harmless, they might be taken to indicate that our language is poor in mechanism, or that we are overpoweringly indebted to our worthy relations, neither of which views is strictly correct. A little consideration might have been shown to our microscope makers by the employment of the well-known English nomenclature of objectives (for a man may be a first-class histologist and yet not know the meaning of Hartnack's No. 10), and the systematic ignoring of their excellent workmanship cannot but produce ill-feeling; for though they may be expensive, they have undoubtedly been the originators of most of the greatest improvements in their branch.

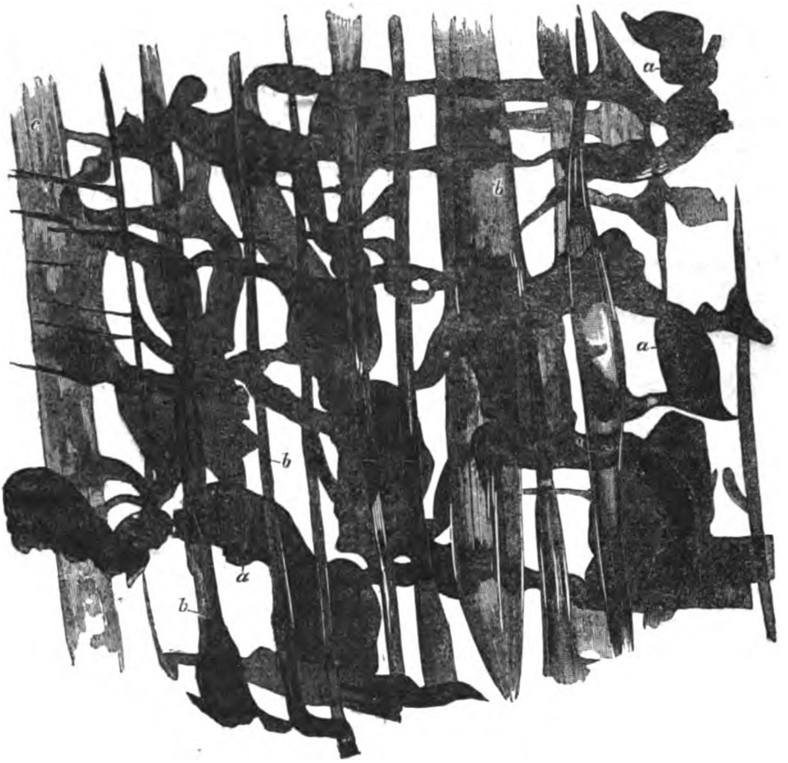

Fig. 1.—Centrum tendineum of rabbit, seen from the abdominal side. Berlin blue had been introduced into the peritoneum by "natural injection." *b*, Straight interfascicular lymphatics between the bundles of tendon of the abdominal side; *a*, lymph vessels of the pleural side, showing the valves, with corresponding dilatations. The last lymph vessels are as completely injected as the first. (Oc., 3 : Obj., 4. Tube not drawn out.)

Dr. Sanderson has undertaken the physiology of the blood, together with that of the circulation, respiration, and animal heat. The chapter on the first of these subjects is excellent and thorough, nothing better could be wanted, the author being able to keep within the region of fact. The German elaborate verifications of the supposed functions of many of the most important nerves, are given in a very lucid and concise manner, and several of the excellent instruments introduced by them are clearly described, together with the principles of their action, and the methods of employing them. But in the other more theoretical subjects, there are many statements to which we must take exception. Most of the theories bearing on some of the main problems in the circulation of the blood, are at the present day in too unsettled a state to find a place in a manual for students, because it is impossible in the permissible space to give the many conflicting results of different authors, which yet remain unproved or unrefuted. The result is, as might be expected, that a one-sided and individual view of the subject is presented, and the student is taught some things which he will have to unlearn. Most of Dr. Sanderson's theories have already appeared, but nevertheless some are based on principles undoubtedly unsound.

Whilst discussing the expansive movements which occur in an artery during the different parts of the pulse beat, and the cause of the variations in the extent of the changes in diameter of the arteries which may be observed, the following occurs :—"A moment's consideration teaches us that there are two circumstances which must diminish the minimum pressure in the arteries, viz., diminution of the mean arterial pressure, and prolongation of the period which intervenes between one expansive act and its successor. In other words, *the less frequent the contractions of the heart and the lower the arterial pressure, the greater the expansion in proportion to the expanding force which produces it*" (the italics are not ours). Dr. Sanderson would undoubtedly thus lead us to believe that this is a self-evident proposition, but that it is so is far from the case. That it should be true it has to be assumed that the escape of blood from the peripheral vessels *between two succeeding pulse beats*, depends on the interval which elapses between them, and no attempt is made to prove this fact, which is not at all necessarily correct, and against which many arguments can be adduced. The same author also adopts a modification of the now antiquated and decidedly insufficient oscillatory hypothesis, to account for the dicrotic beat of the pulse, so clearly seen in the sphygmograph trace: and in so doing he necessarily ignores the great value of the important and very definite results obtained by Chauveau and Lortet, by means of their hæmadromograph; if he had fully realised the easily demonstrable fact that the second rise in the sphygmograph trace *commences* the later in an artery according as it is farther from the heart, the table on p. 228 referring to the relations of the different elements of the pulse beat in different vessels could not have appeared in its present form. As long as physiologists compare arteries to elastic tubes in air, they must be led into error, for the forces which predominate in them so situated, are very different from those which prevail when they are surrounded by water or any yielding substance, which an artery much more directly resembles, as it is surrounded by, and on most sides in contact with, tissues of a somewhat yielding nature. There is another short sentence we must quote; in explaining the action of the auriculo-ventricular valve we read: "The time which intervenes between the commencement of the compression and the tightening of the valve varies according to the vigour of the contractions, the quantity of the blood contained in the ventricle, and the previous position of the valve, must always be appreciable." Does the author really wish us to believe that the heart, a powerful muscular pump, which he affirms (though on very slight grounds) acts most powerfully at the commencement of each beat, requires an appreciable time, by which we understand, one that can be measured by instruments at our command, to tighten the auriculo-ventricular valve, against which the resistance is undoubtedly extremely small? it seems very improbable.

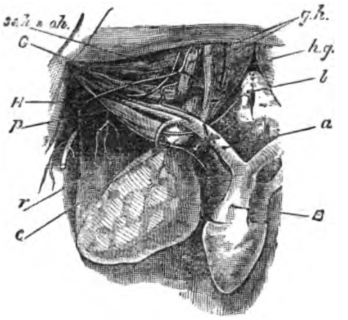

FIG. 2.—Dissection of the parts in relation with the vagus nerve of the frog on the right side. The oesophagus is distended with a glass tube about half-an-inch in width. The object is represented of about twice its actual size *a*, right aorta; B, *bulbus aortæ*: *c*, posterior horn of the hyoid bone; *g h*, genio-hyoid muscle; *h g*, hyo-glossus muscle; *p*, lowest of the three petrohoid muscles; H, ninth nerve; G, glossopharyngeal nerve; *r*, vagus; *b*, larynx; *s* & *h* & *o h*. point to the space occupied by the origins of the large muscle (sternohyoid) which connects the hyoid with the sternum, as well as by the omohyoid; both of these muscles have been cut away.

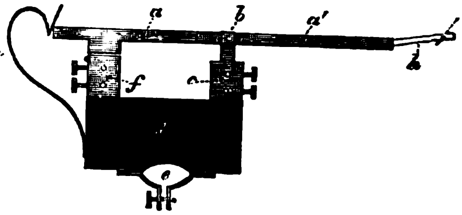

FIG. 3.—The marking lever for indicating graphically on a revolving drum the moment at which an electric current is broken.

The chapter on animal heat contains much useful information, but several of Senator's results are not entered into, and Laschkewitsch's explanation of the fall of temperature in "varnished" rabbits, which are discussed in detail, is not given. None of the special precautions which have to be taken in employing the mercurial thermometer for physiological investigation, are referred to; and the student will be entirely misled respecting the principle upon which the ordinary clinical thermometer of Phillips is constructed, the author having muddled up with his description Hawksley's method for preventing the index running into the bulb whilst the operator is depressing it, which is entirely independent of, and has nothing to do with, the self-registering power of the instrument. A similar want of knowledge of physics is shown on the same page on which this error occurs, for it is stated that in the thermometric couple the degree of deflection of the galvanometer needle, which is produced when a current results from the unequal heating of its ends, varies with the difference of the temperature of the junctions, which is well known to be incorrect.

Dr. Foster, in undertaking the "Functions of Muscle and Nerve," has undoubtedly had a difficult work to perform, and he has introduced a very clear and simple method of teaching the various, and in many cases, disconnected facts which relate to them. The student will, in this section of the work, find full directions for performing most of the experiments, which will, when all repeated, enable him to advance on a thorough and sound foundation. Great care is taken to render evident the phenomena of electrotonus, and the subject of tetanus is dwelt on in detail, the following being the propositions which are discussed and proved regarding it:—1. "Tetanus from an ordinary interrupted current is a continuous contraction rapidly reaching a maximum, continuing (within limits) in that condition so long as the current is passing, and followed by a gradual relaxation upon the current being cut off." 2. "Tetanus really consists of a series of simple muscular contractions fused together." The apparatus necessary for verifying these and other points in which electricity plays a part, is described as far as is necessary for the wants of the physiological student, and some, as Wippe's double key and Du Bois Reymond's rheocord, are figured. Several of the points insisted on appear to be insignificant in themselves, but they must all, in the long run, have important bearings on future theory.

In undertaking the "Physiological Chemistry," Dr. Brunton has had a somewhat easier task than the two authors last referred to, and his work is excellent. The results of Hoppe-Seyler, and other German chemists, which are as convincing as they are connected, are fully entered into, and the chemistry of digestion and excretion, together with the method of arriving at them, are explained at considerable length. As an instance of the manner in which the subject is handled, the following are the propositions which are demonstrated in connection with the fact that pepsin is not destroyed during digestion. 1. "Although the digestive power of pepsin appears to be indefinite, yet a limited quantity of gastric juice will not dissolve an unlimited quantity of fibrin." 2. "The arrest of digestion in this experiment (the proof of the previous proposition) is not due to the destruction of pepsin, but to the accumulation of the products of digestion in the liquid and to the want of acid." 3. "A stronger acid is required for digestion if the products of digestion are present in quantity in the solution." The theory of digestion, together with the action of the vagus and splanchnics on the stomach are fully discussed, and the unassuming way in which the author states his own opinions carries great weight with it.

We should have liked to have seen a separate chapter on the methods to be used for rendering animals insensible, together with a notice of the relative value of different anæsthetics and the way to exhibit them; as it is, the subject is only incidentally mentioned in connection with special operations. If the drawings of the instruments had been incorporated in the text they would have been more easily referred to, and therefore more frequently looked at; as it is, the one volume without the other is difficult to understand. The anatomical sketches, mostly after Bernard, which illustrate the distribution and relations of the nerves and vessels that so frequently have to be manipulated by operating students, adds much to the completeness of the work, in which every effort has evidently been made to put the student in as good a position with regard to the subject as can be desired.

The three accompanying woodcuts are from the second volume of this work. The largest is an example of the size and character of the excellent illustrations in Dr. Klein's histological section. Dr. Sanderson contributes that illustrating the relations of the pneumogastric nerve in the frog, and the third is one of the several electrical instruments described by Dr. Foster.

WILSON'S INORGANIC CHEMISTRY.

Inorganic Chemistry. By the late George Wilson. M.D., F.R.S.E. Revised and enlarged by H. G. Madan, M.A. (London and Edinburgh: W. and R. Chambers.)

LIKE so many of our old friends among the best books on chemistry, the present edition of the late Prof. Wilson's Inorganic Chemistry has undergone somewhat extensive alterations, and received considerable additions, which, in the opinion of its able editor, have been rendered necessary by the recent progress of chemistry. The original plan, which is that adopted in some of our best text-books, has been adhered to, viz. of introducing the student to a knowledge of the more important fundamental laws of chemistry, and to make him familiar with the properties of the chief elementary substances, and their more remarkable compounds. What is generally known by the name of chemical physics occupies about one-fourth of the whole book. This portion is clear and concise, and deserves the highest eulogium. It may be perused with advantage by every chemical student. The theory of atomicity of elements, which is fast giving a new impression to organic chemistry, and which by some of our most eminent chemical teachers has of late been introduced into the domain of inorganic chemistry also, and which promises to reconcile and harmonise both branches of chemical science, has received but scanty recognition at the hands of the editor, although he professes to have brought the chemical nomenclature (in deference to the wishes of the publisher), into accordance with the system adopted by Profs. Frankland and Williamson.

Professor Wilson seems to have felt that physical and chemical laws cannot be studied with advantage without having some physical and chemical facts to work upon, and the pupil is therefore recommended to read the first 108 pages, treating of chemical physics, with some care before proceeding further; but "he is not to expect to understand the introductory portion at once, but must go back from time to time to their study, when he will find them more and more intelligible as he grows familiar with the properties of chemical substances," explained in the later pages. Is not this an admission that the plan upon which the book is constructed is a faulty one? Is it not time to relegate chemical physics to physics proper, especially when we have such excellent elementary text-books as Balfour Stewart's and others, and to treat of chemical changes in chemical text-books? Not that we would have it inferred that chemical changes can be understood without a knowledge of the general properties of matter, of heat, light, and electricity. By far the greater number of chemical changes being dependent upon chemical affinity, the laws of chemical combining proportions and volume composition can very well be explained by confining the teaching at first mainly to chemical changes. Physical considerations, especially at a time when they undergo such rapid extensions, should form the crowning part of chemical studies, and the interdependence of the two branches of science can only be established upon a sound basis when a thorough knowledge of either science has been acquired.

The main portion of the book comprising the chemistry of the non-metallic and metallic elements, arranged under the usual headings Preparation and Properties of the different elements and their compounds, contains much that will highly recommend itself. The more important compounds are dealt with in a manner which will help the student over most of the difficulties he encounters at first, and will enable him to lay a good foundation for more extensive chemical studies. The classification of the metals according to their atomicity—open to objections as it stands—is not always reconcilable with the analytical summaries or tests given after each group of metals, nor are the analytical explanations always accurate. On p. 393, *e.g.* we notice: "Calcic sulphate cannot produce a precipitate in a salt of calcium, because there is more than enough of water present to retain dissolved all the sulphate that can possibly be formed."

There can be little doubt that the new edition of Wilson's Chemistry will be welcomed by all who desire to get a general insight into the science, and that it may be studied with advantage in preference to many larger and more ambitious text-books.

OUR BOOK SHELF

Verhandlungen der k. k. geologischen Reichsanstalt. Nos. 11 to 18. (Vienna.)

THESE numbers of the Proceedings of the Geological Society contain many useful papers, chiefly, however, of local interest. Felix Karrer notes the occurrence of mammoth remains at Vienna. They were obtained during the sinking of a well in a "diluvial" (glacial) deposit at a depth of 9 fath. 3 ft. from the surface. Dr. Lenz also has a short reference to a similar discovery of the teeth of a young mammoth in a brown laminated loam near Nowakmühle. Dr. Stur gives an interesting account of his own and Baron Petrino's observations on the superficial deposits in the basin of the Dniester in Galicia and Bukowina. A great accumulation of loess covers a wide area in that district, the land shells and mammalian remains in which enable these geologists to correlate it with the loess of the Rhine and other regions. We observe, in No. 11, an important table showing Dr. C. E. Weis's systematic arrangement of the carboniferous formation and the rothliegendes formation of the Saar-Rhine district, which is well worth the attention of English geologists. The usual admirable literary notices, and other miscellaneous matter, are appended to each number of the Proceedings.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Leaf-Arrangement

THE chief part of the Rev. G. Henslow's objections (NATURE, vol. vii., p. 403) to my condensation-theory of leaf-arrangement are due to a double oversight on his part. First, he has overlooked the condition of *contact* among the balls which I use to represent embryo leaves. Second, he has overlooked the fundamental position, that leaf-order exists for, and is determined in, the *bud*.

The bud requires economy of space. This involves contact among the embryo leaves; and if we experiment with balls attached (as described in my paper) in two rows alternately on either side of a contractile axis, we shall see that when the axis is allowed to contract with a twist, that twist is necessarily limited by the conditions of contact which arise, and that we cannot "cause it to make a complete rotation if we choose." Given the size of the balls and their distance from the axis, the position which they will assume (under contraction with a twist) is necessarily determined by the geometrical conditions of mutual contact. This consideration furnishes the answer to Mr. Henslow's italicised query, and also to his two previous questions (1) and (2). It also gives back a "really explanatory meaning" to my expression "*maxima* of stability," for if we have one sphere standing almost vertically on another and supported by a third and a fourth to right and left, we have therein some statical conditions which admit of maxima and minima of stability. The same consideration also removes the objection that "the positions taken up by the balls must be arbitrary, or at least in proportion to the twist given by the hand—a perfectly arbitrary force." The twist given by the hand in my experiment serves only to determine the direction of the real twist; the subsequent real availing twist is insisted upon by the two ranks of balls-in-contact as the sole condition of obedience to the contractile force of the indiarubber axis; and this twist is limited by the conditions of contact above described. Let the direction of the twist be given, and there is nothing arbitrary in the result.

The objection that "if an axis becomes twisted the *fibres* will be twisted also" loses force if we bear in mind that the leaf-order is imposed upon the embryo leaves in the very earliest stage of their bud-life; and that the formation of fibres, taking place at a subsequent stage, must find itself compromised by an already existing arrangement of the embryo leaves. The elastic band in my experiment, "if it were a pliant shoot," would certainly "contort the vessels and wood-fibres;" but it was not meant to represent a "pliant shoot" except in its earliest embryonic bud-stage, and that at some very remote period in the past.

I must ask Mr. Henslow to bear in mind that he has before him only the abstract of my paper, and that necessary brevity has left some points too bare, and has wholly suppressed others of small importance. Among the latter is some mention of the "secondary series" $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$, &c., which, though it may be found in the abnormal variations exhibited by a cultivated plant like the Jerusalem Artichoke, yet cannot be reckoned with examples of normal leaf-order.

Let me take this opportunity of insisting again on the astonishing agreement between the facts of nature and the results which the condensation-theory leads us to expect. Taking one member to start from as 0, we find in nature that the members in contact with 0 belong to the following series, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, &c., and these are the very same members which would necessarily be brought into contact with 0 under successive degrees of condensation with twist from an original order $\frac{1}{2}$.

I have lately met with a striking confirmation of the truth of the condensation-theory. The simplest order of the whorled type is that in which the leaves stand in pairs, decussate. Now if we consider what would be the result of condensation with twist applied to this arrangement, we can see that it would produce a new series of orders, in which the following members would successively come into contact with 0,—2, 4, 6, 10, 16, 26, 42, &c., and would present the phenomenon of 2, 4, 6, 10 &c., spirals alternately to right and left. This result is exemplified in nature. The teazle (*Dipsacus silvestris*) has the decussate order in its leaves; and in its head (where we might expect to find its leaf-order condensed) we count sixteen conspicuous spirals in one direction and twenty-six in the other:—that is to say, we have 0 in contact with No. 16 on one side and No. 26 on the other. No. 42 stands higher between 16 and 26, but inclined towards the former. No. 10 stands next below 26, and No. 6 next below 16. These numbers belong to the new series above mentioned.

This close parallel between fact and theory appears to me to give a value to the latter which it will not lightly lose.

March 30 HUBERT AIRY

The Hegelian Calculus

As Dr. J. H. Stirling has enjoyed the exceptional privilege of replying contemporaneously to my paper on Hegel in the current number of the *Fortnightly*, I should desire, with your kind permission, to find in your columns the opportunity of saying without delay the single word which still seems necessary between Dr. Stirling and myself.

Dr. Stirling now holds that the real question between him and me is whether or not Hegel "attempted" to produce "a Hegelian Calculus." And so it seems to him a virtual concession of the entire case when I say that the phrase "Hegelian Calculus" is used by me in irony. Dr. Stirling, I fear, misunderstands me. What Hegel has given us on the subject of the Calculus is, strictly speaking, nonsense. But, as I have shown, this nonsense is not mere metaphysic, but involves mathematical absurdity. It is of course only in irony that one can dignify the paradoxes of mathematical ignorance with the title of a Calculus; and if this admission satisfies Dr. Stirling, then our controversy is at an end. W. ROBERTSON SMITH

Aberdeen, April 3

Meteorology of the Future

I WISH to call the attention of the writer of the article "The Meteorology of the Future," which appeared in NATURE of December 12, 1872, to a little work which appears to have entirely escaped his notice.

In the beginning of 1871 I circulated a small book of twenty-four pages, containing results deduced from the observations made at this Observatory, 1841 to 1870. I have given the decimal and annual variations of all the meteorological elements collected, and have pointed out their mutual interdependence. I have also given on an enlarged scale the curves of variations of annual mean temperature and freedom of the sun's disc from spots, which appeared in the Proceedings of the Royal Society, March 23, 1871.

No one acquainted with the subject would, I presume, believe that periodical variations could exist in the temperature without existing also in the other meteorological elements; vapour as measured by tension, hence barometer humidity and rainfall.

In the introduction to the work referred to, it is stated with regard to the curve of temperature and inverse curve of solar spots:—"There is an agreement between the curves which will probably be regarded as too close to be the result of accident, and which renders it probable that the two phenomena, represented by the curves, result from the action of a common cause connected with changes of mean solar energy." And this established with more or less probability, I proceeded to point out (p. 17)—"That the variations of temperature are borne out by those of tension of vapour," and on page 22—"That the correspondence between humidity and rainfall is strongly marked," and also that—"The correspondence between a curve swept to represent the variations in rainfall and the inverse curve of the variations in mean temperature is of a marked character."

You will perceive, therefore, that the connection between solar spots as an indication of less solar heating power and vapour, and rain, as well as temperature, was in the book referred to explicitly pointed out. I may add to this note, that the rainfall for

1871 was 20·098 inches
1872 was 29·325 inches.

E. J. STONE

Royal Observatory, Cape of Good Hope

Bright Meteor

I HAVE this evening, at 7.40, seen the brightest meteor I have ever beheld: starting from a point about half-way between Cassiopeia and the Pole star, it descended through about 20° of arc, when it was lost sight of behind a cloud: this cloud was a thick white opaque cloud shining brightly in the moonlight, but the meteor behind it illuminated the sky, and made the cloud appear for the moment dark against it.

The colour of the meteor was a decided green; its passage was not very rapid; it appeared far brighter than any star or planet, and seemed to have a short tail. Not only was it a gloriously beautiful object in itself, but it illuminated all the sky in its neighbourhood with its greenish light.

EDMUND H. VERNEY, Commander R.N.

H.M.S. *Growler*, off Cape Matapan, March 5

The Great Meteoric Shower of November 27, 1872

THIS interesting display was also observed in the neighbourhood of the small town of Santa Lucia in Venezuela (10° 12′ N., 68° 57′ W. from Paris), by Dr. A. Alamo. The first meteors were seen at half-past 7, about 100 in 30 minutes. Most of them followed an easterly course, some leaving a luminous track visible for several minutes. From 8 to 12 o'clock their number was too large for counting, but after midnight the weather got misty, and few meteors could be distinguished. The shower, however, continued, and still in the morning some meteors were traceable. Unfortunately Dr. Alamo cannot say anything about the radiant point of the shower. At Carácas the sky was densely overcast, and not even a glimpse of the spectacle could be obtained. DR. A. ERNST

Carácas, Feb. 21

The Antiquity of Man

THE letter of Sir John Lubbock in your issue of March 27, induces me to call attention to what seems to me to be an anomaly in the state of our evidence concerning fossil man. Sir J. Lubbock has insisted, and with much reason, on the parallelism between the condition of existing savage races and that of fossil man; but, I would ask, is there any existing savage race capable of delineating animals in the masterly way in which the elephant is delineated on the plate of bone figured at page 326 of NATURE (February 27, 1873)? Such a life-like representation as is here produced by a few rough scratches would not discredit a modern artist. Unless I am under a misapprehension, the best figures that living savages can produce are but uncouth things, in which case either the parallelism between the intelligence of existing savage races and of fossil man fails in one important particular, or else a suspicion arises as to the contemporaneity of these engraved bones with palæolithic man; and a doubt is thrown on the supposed antiquity of the Troglodytes to whose hands this engraving is ascribed.

We should, I think, until this discrepancy is explained, look with still greater suspicion upon the contemporaneity of engraved representations of animals with so early a form as Miocene man, or accept them as any evidence of his existence at that epoch.

While suggesting the above caution, I would not, however, be understood to dissent from the probability of some form of man having existed as far back as the Miocene period, since eleven years ago, I observed in the *Phil. Mag.* (for April, 1862, last paragraph but one of the paper) that the views there discussed "seemed to me to lead us to the presumption of a far greater antiquity for our race than had hitherto been accorded to it, reaching perhaps far back into the Tertiary period."

Brentwood, Essex SEARLES V. WOOD, JUN.

Skeletons at Mentone

A VERY accomplished geologist, a friend of mine, is now staying at Mentone, for the benefit of his health, and he writes to me under the date of the 25th ult. as follows:

"Another skeleton has just been found here in one of the caverns. It is far less perfect than the former one. The head is crushed and partly wanting, and a considerable portion of the vertebral column is absent. The limbs, however, indicate a person of larger size than the first skeleton. On the arms are bracelets of shells, which are bored for stringing. The parts found are lying in their natural position With the skeleton are traces of what looks like very fine iron ore. Of this substance there is but a very small quantity, perhaps two or three tablespoonfuls."

With regard to the iron ore, there have been many conjectures, and it is extremely remarkable that about the same quantity of a similar substance was found with the first skeleton. The more general opinion seems to be, that this material was employed in some burial rite. W. T.

Torquay, April 1

[From a cutting from *Les Echos de Cannes* sent us by W. T., we learn further that the head was covered by a network of shells, and that beside the skeleton were found many implements of bone, and even drawings of fish and swans.—ED.]

Instinct

Perception in Ants

THE following fact with respect to the habits of ants, which I believe to be quite new, has been sent to me by a distinguished geologist, Mr. J. D. Hague; and it appears well worth publishing. CHARLES DARWIN

On the mantelshelf of our sitting-room my wife has the habit of keeping fresh flowers. A vase stands at each end, and near the middle a small tumbler, usually filled with violets.

Sometime ago I noticed a file of very small red ants on the wall above the left-hand vase, passing upward and downward between the mantelshelf and a small hole near the ceiling, at a point where a picture-nail had been driven. The ants, when first observed, were not very numerous, but gradually increased in number, until on some days the little creatures formed an almost unbroken procession, issuing from the hole at the nail, descending the wall, climbing the vase directly below the nail, satisfying their desire for water or perfume, and then returning. The other vase and tumbler were not visited at that time.

As I was just then recovering from a long illness it happened that I was confined to the house, and spent my days in the room where the operations of these insects attracted my attention.

Their presence caused me some annoyance, but I knew of no effective means of getting rid of them. For several days in succession I frequently brushed the ants in great numbers from the wall down to the floor; but as they were not killed the result was that they soon formed a colony in the wall at the base of the mantel, ascending thence to the shelf, so that before long the vase was attacked from above and below.

One day I observed a number of ants, perhaps thirty or forty, on the shelf at the foot of the vase. Thinking to kill them I struck them lightly with the end of my finger, killing some and disabling the rest. The effect of this was immediate and unexpected. As soon as those ants that were approaching arrived near to where their fellows lay dead and suffering, they turned and fled with all possible haste. In half an hour the wall above the mantelshelf was cleared of ants.

During the space of an hour or two the colony from below continued to ascend, until reaching the lower beveled edge of the shelf, at which point the more timid individuals, although unable to see the vase, somehow became aware of trouble and turned about without further investigation; while the more daring advanced hesitatingly just to the upper edge of the shelf, where, extending their antennæ and stretching their necks, they seemed to peep cautiously over the edge until beholding their suffering companions, when they too turned and followed the others, expressing by their behaviour great excitement and terror. An hour or two later the path or trail leading from the lower colony to the vase was almost entirely free from ants.

I killed one or two ants on their path, striking them with my finger, but leaving no visible trace. The effect of this was that as soon as an ant ascending towards the shelf, reached the spot where one had been killed, it gave signs immediately of great disturbance, and returned directly at the highest speed possible.

A curious and invariable feature of their behaviour was that when such an ant, returning in fright, met another approaching, the two would always communicate, but each would pursue its own way; the second ant continuing its journey to the spot where the first had turned about and then following that example.

For several days after this there were no ants visible on the wall, either above or below the shelf. Then a few ants from the lower colony began to re-appear, but instead of visiting the vase which had been the scene of the disaster, they avoided it altogether, and following the lower front edge of the shelf to the tumbler standing near the middle, made their attack upon that. I repeated the same experiment here with precisely the same result. Killing or maiming a few of the ants and leaving their bodies about the base of the tumbler, the others on approaching, and even before arriving at the upper surface of the shelf where their mutilated companions were visible, gave signs of intense emotion, some running away immediately and others advancing to where they could survey the field, and then hastening away precipitately.

Occasionally an ant would advance towards the tumbler until it found itself among the dead and dying, then it seemed to lose all self-possession, running hither and thither, making wide circuits about the scene of the trouble, stopping at times and elevating the antennæ with a movement suggestive of wringing them in despair, and finally taking flight.

After this another interval of several days passed during which no ants appeared. Now, three months later, the lower colony has been entirely abandoned. Occasionally however, especially when fresh and fragrant violets have been placed on the shelf, a few "prospectors" descend from the upper nail hole, rarely, almost never, approaching the vase from which they were first driven away, but seeking to satisfy their desire at the tumbler. To turn back these stragglers and keep them out of sight for a number of days, sometimes for a fortnight, it is sufficient to kill one or two ants on the trail which they follow descending the wall. This I have recently done as high up as I can reach—three or four feet above the mantel. The moment this spot is reached an ant turns abruptly and makes for home; and in a little while there is not an ant visible on the wall.

JAMES D. HAGUE

San Francisco, California, Feb. 26, 1873

Perception in Butterflies

THE interesting discussion on this subject in your columns has hitherto been almost entirely confined to facts of extraordinary "perception" with mammalia. But in other classes of the animal kingdom there occur instances perhaps even more astonishing still, showing a power of perception which we needs must attribute to smell, unless we are inclined to talk about natural forces hitherto unknown, to which I should prefer saying that we do not yet understand the matter at all.

In the valuable monthly, "Der Zoologische Garten," v. I. (1869) p. 254, there is a paper on the sense of smell in butterflies, recording, among other cases, the following one.

A well-known collector, the late M. Riese of Frankfort, brought a crippled female of *Lasiocampa pruni*, a species very rare here. M. Riese dwelt in a narrow and densely-peopled lane near the centre of this city. He put the said moth before the window with his other boxes, and soon had the pleasure to find it surrounded by some males, which became the collector's welcome prey. Here, as the writer fitly remarks, the performance of the male in finding out the female was the more surprising, by the latter being confined in the middle of the town as well as by the rarity of the species in general.

If, as the writer adds, there can be any doubt of the males being guided in these cases by smell, what is more to be wondered at, the acuteness of the males (supposed to be located in the large comb-shaped antennæ) or the enormous divisibility of the odour emitted by the females?

I may add that similar and even more striking cases (the females being confined within a room, and the males appearing outside at the windows) have been recorded by that most reliable observer, the late Dr. von Heyden.

Though I am not prepared to follow the whole length of Mr. Darwin's ideas on "Pangenesis," yet I cannot avoid observing how much such facts as these seem to support the fundamental assumption of that "provisional hypothesis," namely that organised matter is capable of a degree of divisibility scarcely conceivable by us, yet retaining in those most minute particles, infinitely smaller than any which can be revealed by our microscopes, all its specific distinctness,—the "gemmules" issuing from the female of a particular species reaching and affecting the distant male, and thereby testing their particular, specific nature.

J. D. WETTERHAN

Frankfort-on-the-Maine, April 5

Perception in Fowls

SEEING in NATURE many letters on the instinct of animals I am tempted to send you an incident which fell under my notice and which would seem to denote in domestic fowls a greater amount of reasoning power and of intercommunication than the lower animals are usually credited with.

Three years ago I was staying at a house in Ireland where a good deal of poultry was kept, and a young white duck just feathered being the only one left of a brood was allowed to roost with a hen and a young brood of chickens under the furnace in the back kitchen, to keep it from the rats which infested the out-houses. One evening our attention was called by the servants to a great commotion between the hen and the duck, which had always before been excellent friends, and upon close examination it was discovered that the duck was not the hen's usual companion, but although closely resembling it in age and colour, was a perfect stranger, not even belonging to the premises at all, whilst the proper duck was found quietly resting with the other ducks in the duck-house. The intrude having been ejected, and the ordinary bed-fellow restored to th hen, peace again reigned between the feathered companions but the singular part of the affair is, how the duck could ha met with a stranger so nearly like herself, and induced it to take her own nightly place in a strange house and with a strange hen. —Was it an act of charity towards a stranger wandering in search of a night's lodging? or was the duckling tired of the hen's company, and desirous of joining the birds of her own feather, and so cajoled the stranger so nearly resembling herself to take her place, believing the cheat would not be discovered?

I commend this fact, for which I can vouch, to Mr. Darwin.

A. W. BUCKLAND

Bath, March 31

Acquired Habits in Plants

ON Oct. 24 last, I found by the banks of the little river Aled, in North Wales, a dog-violet, which, in the first place, was in flower at that unusual season, and in the second place, growing in a hedge, had assumed the habit of a climbing plant. Its stem measured 2¼ feet in length; it bore sixteen alternate leaves, the flowers being axillary, or rather some axils had flowers in them, and others had branches of leaves with flowers axillary in these. One flower only was actually in bloom, but there were several (five or six) seed vessels. I gathered one plant and have it still.

St. Asaph, N. Wales J. G.

SCIENCE AND THE PRESS IN AMERICA

(FROM A NEW YORK CORRESPONDENT)

THE visit of Prof. Tyndall has given an extraordinary impulse to scientific affairs in this country. It took place at a fortunate moment, just after the heat and turmoil of a presidential election had been transformed into the national sorrow over the death of the defeated candidate; just before the exposures of corruption, which have since disgraced eminent public men, had begun to absorb popular attention. It therefore happened not only that men's minds were not preoccupied, but that, in addition, newspaper columns were not specially crowded. Hence all the leading newspapers gave more space than would have otherwise been possible, to reports of Prof. Tyndall's lectures. In this particular, however, one paper surpassed the rest, giving the lectures verbatim and with illustrations, and afterwards reprinting them in a separate sheet, which, as you are probably already informed, attained a special circulation outside that of the newspaper, of more than 200,000 copies. It is not improbable that this enterprise on the part of the *New York Tribune* originated in a programme for the management of that paper laid down by the late Mr. Greeley. This was printed in its columns the second day after the election, when he resumed his position as editor of the paper. The card specified among other things, first, that thereafter the paper would be enabled to give "a wider and steadier regard to the progress of science, industry, and the useful arts." His successors in the management of the paper have been anxious, for obvious reasons, that it should tread the path he had marked out for it; Tyndall's coming furnished the first opportunity. Other papers have been stimulated by the popularity of scientific topics which the success of these lectures revealed, and there never was a time when such themes found such general acceptance with the newspaper press.

The first manifest benefit to science which has resulted, is an improvement in the treatment of scientific subjects, so far as they are editorially considered. It is not a year since one of the New York newspapers contained an article upon a proposition to light streets and houses by means of hydrogen and oxygen conveyed in separate systems of pipes. In that article there was displayed an ignorance of the commonest facts of chemistry that seemed almost incredible. It teemed with the most ludicrous absurdities. But even its rivals never perceived the blunders—they had a fair share of their own, for the most part, whenever they handled such topics. But of late the writers in the New York newspapers have exhibited some knowledge of such subjects; at all events, special articles in some of the papers betray the touches of a professional hand, that come not with the surface knowledge of journalism.

The second evident benefit has to-day a signal illustration. The efforts of Prof. Tyndall were particularly directed toward impressing upon those of our citizens who have the means for such aid, the benefit that results to the community from the promotion of scientific inquiry This has been also a favourite theme with Prof. Agassiz. A few days ago a Boston correspondent of the *New York Tribune* sent a description to that paper of the work that Prof. Agassiz had undertaken at the Museum of Comparative Zoology; his efforts to obtain State assistance from the Massachusetts legislature; his needs and difficulties, and unsparing, disinterested industry; his project for founding a school of natural history on the coast of Nantucket, where practical work with the dredge might enable the students to become acquainted with marine organisms in a condition of nature. The newspaper commented on the correspondence, pointing out the value of such services, of such researches. The letter and comment interested Mr. John Anderson of this city —a gentleman who has gained wealth as a tobacco manufacturer. Some years ago, finding his health suffering from too close application to business, he selected as a salubrious retreat an island on the New England coast. It is one of the Elizabeth Islands, between Vineyard Sound and Buzzard's Bay. You will best know just where this is, by the fact that New Bedford, the old whaling port of Massachusetts, is on Buzzard's Bay. He expended about 25,000 dols. in improving Penikese Island, and in its delicious climate he regained his health. He refused 75,000 dols. for the island, valuing it at 100,000 dols. Last week, after reading about the aims and efforts of Prof. Agassiz, Mr. Anderson wrote to him, offering him Penikese Island as a gift, and saying to him that he could there establish his Marine Naturalist's School.

To be a little more specific—as such a munificent gift deserves: Penikese is the most northerly of the three western islands of the Elizabeth group. It is of great fertility; it contains a good summer residence; looks out upon a beautiful bay, where there is good anchorage; has a stone dock, and springs of good water. Here is everything that Prof. Agassiz wanted for his semi-nautical enterprise.—Stay! not everything. When Prof. Agassiz first recovered from his surprise, and was thanking the donor, he mentioned a little embarrassment. He had made his arrangements for Nantucket, and there was a little money expenditure involved in the change. "Let not that trouble you" writes Mr. Anderson, and straightway proffers a money-gift in addition—50,000 dols. in cash, "as a nucleus for a permanent endowment fund." And Prof. Agassiz, his heart as well as his coffers running over, says that now his enterprise shall not be merely a summer school, but an institution for all seasons and all time.

The correspondence between Mr. Anderson and Prof. Agassiz will, I am told, be furnished to the press within a few days; but Mr. Anderson is modest; and does not want much fuss about it. It is his first approach toward the hill of science, and he had no personal acquaintance with Agassiz whatever. The scientific sensation of today's newspapers is a story that the Natural Bridge of Virginia is burning up. It is told with great detail by eye-witnesses who testify to volcanic burnings and a sulphurous smell, to falling rocks and general danger. Prof. Campbell, of the geological department of the Washington and Lee University, evidently credits the story, and attributes the phenomenon to chemical action, induced by high water acting upon sulphurous and bituminous deposits containing metallic oxides. A New York paper decries the whole story, asserting that the fire proceeds from tar-barrels, and that the whole display is in the interest of hotel-keepers anxious to excite curiosity and attract custom.

ON THE ORIGIN AND METAMORPHOSES OF INSECTS

I.

THE CLASSIFICATION OF INSECTS

NOT many years ago the civil and ecclesiastical authorities of St. Fernando in Chili arrested a certain M. Renous on a charge of witchcraft, because he kept some caterpillars which turned into butterflies.[*] Most persons, however, are aware that the great majority of insects quit the egg in a state very different from that which they ultimately assume; and the general statement in works on entomology has been that the life of an insect may be divided into four periods. Thus, according to Kirby and Spence[*] "The states through which insects pass are four: the *egg*, the *larva*, the *pupa*, and the *imago*."

Burmeister,[†] again, says that, excluding certain very rare anomalies, "we may observe four distinct periods of existence in every insect, namely, those of the egg, the larva, the pupa, and the imago, or perfect insect." In fact, however, the various groups of insects differ very much from one another in the metamorphoses they pass through; in some, as in the grasshopper for instance, the changes consist principally in a gradual increase of size, and in the acquisition of wings; while others, as for instance the common fly, acquire their full bulk in a form very different from that which they ultimately assume, and pass through a period of inaction in which not only is the whole form of the body altered, not only are legs and wings acquired, but even the internal organs themselves, are almost entirely distintegrated and reformed. It will be my object to bring these changes clearly before you, and if possible to throw some light on the causes to which they are due, and on the indications they afford of the stages through which insects have been evolved.

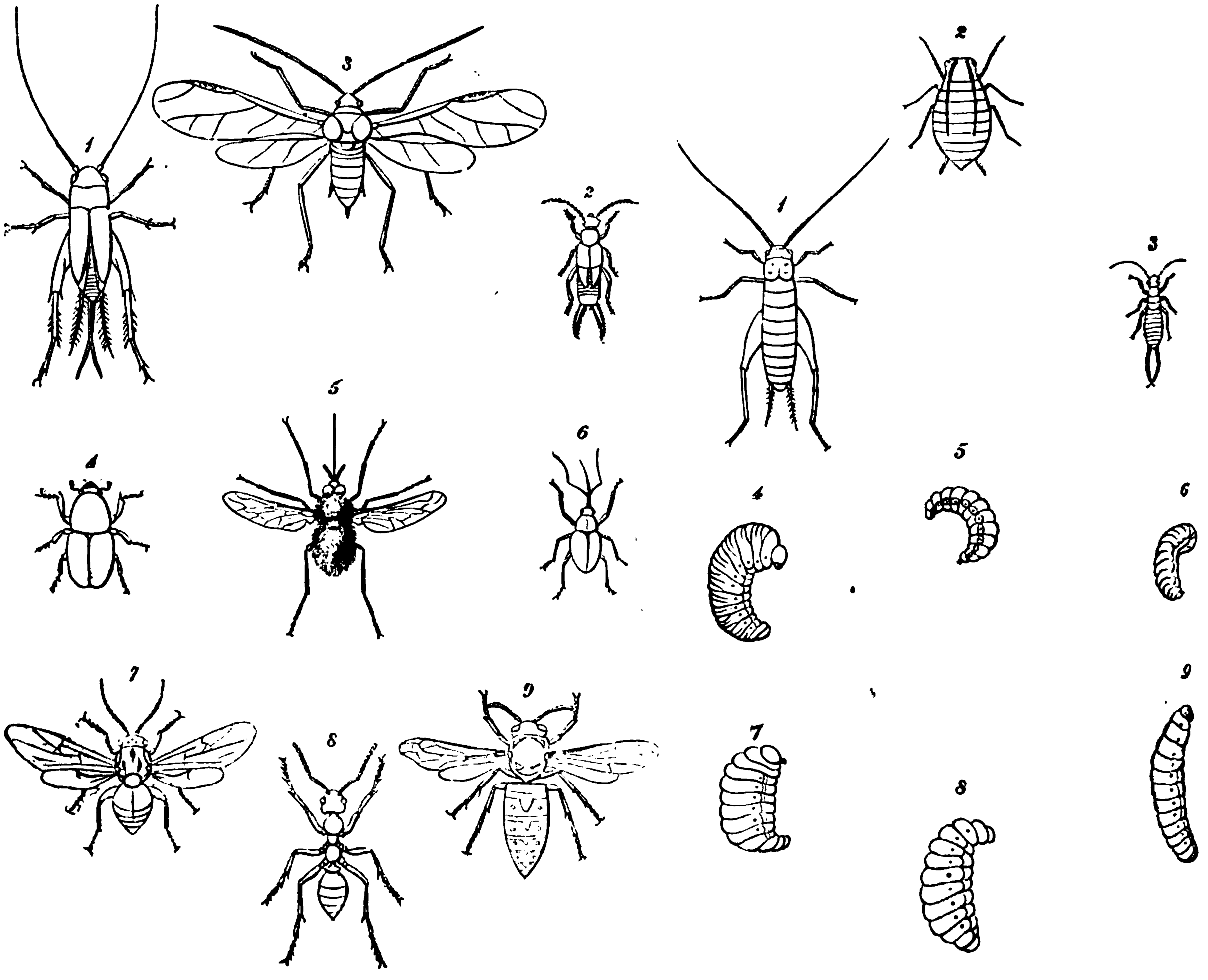

PLATE 1 PLATE 2

PL. 1.[‡]—FIG. 1, Cricket. 2, Earwig. 3, Aphis. 4, Scolytus. 5, Anthrax. 6, Balaninus. 7, Cynips. 8, Ant. 9, Wasp (after Ormerod).
PL. 2.—FIG. 1, Larva of Cricket. 2, Larva of Aphis. 3, Larva of Earwig. 4, Larva of Scolytus. 5, Larva of Anthrax. 6, Larva of Balaninus. 7, Larva of Cynips. 8, Larva of Ant. 9, Larva of Wasp.

The following list gives the orders or principal groups into which insects may be divided. I will not indeed, as this is not a work on the classification of insects, enter into my own views, but have adopted the system given by Mr. Westwood in his excellent "Introduction to the modern Classification of Insects," from which also, as a standard authority, most of the figures on Plates

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[*] Darwin's "Researches into the Geology and Natural History of the Countries visited by H.M.S. *Beagle*," p. 326.

[*] Introduction to Entomology vi. p. 50.

[†] Manual of Entomology, p. 30.

[‡] When not otherwise acknowledged, the figures on the first four plates are principally borrowed from Mr. Whetwood's excellent "Introduction to the Modern Classification of Insects."

1 to 4, when not otherwise acknowledged, have been taken. He divides the insects into thirteen groups, with reference to eight of which it may be said that there is little difference of opinion among entomologists. These orders are by far the most numerous, and I have placed them in capital letters. With reference to the other five there is still much difference of opinion. It must also be observed that Prof. Westwood omits the parasitic Anoplura, as well as the Thysanura and Collembola.

Orders of Insects according to Westwood.

1. HYMENOPTERA . .	Bees, Wasps, Ants, &c.
2. Strepsiptera . . .	Stylops, Zenos, &c.
3. COLEOPTERA . . .	Beetles.
4. Euplexoptera . .	Earwigs.
5. ORTHOPTERA . .	Grasshoppers, Crickets, Cockroaches, &c.
6. Thysanoptera. . .	Thrips.
7. NEUROPTERA . .	Ephemeras, &c.
8. Trichoptera . . .	Phryganea.
9. DIPTERA	Flies and Gnats.
10. Aphaniptera . . .	Fleas.
11. HETEROPTERA . .	Bugs.
12. HOMOPTERA . .	Aphis, Coccus, &c.
13. LEPIDOPTERA . .	Butterflies and moths.

Of these thirteen orders, the eight which I have placed in capital letters, namely the first, third, fifth, seventh, ninth, eleventh, twelfth, and thirteenth, are much the most important in the number and variety of species. The other five are comparatively small groups. The Strepsiptera are minute insects, parasitic on Hymenoptera. Rossi, by whom they were discovered, regarded them as Hymenopterous; Lamarck placed them among the Diptera; by others they have been considered to be most closely allied to the Coleoptera, but they are now generally treated as an independent order.

The Euplexoptera or Earwigs are only too familiar to most of us. Linnæus classed them among the Coleoptera, from which, however, they differ in their transformations. Fabricius, Olivier, and Latreille regarded them as Orthoptera, but Dr. Leach, on account of the structure of their wings, considered them as forming the type of a distinct order, in which view he has been followed by Westwood, Kirby, and many other entomologists.

The Thysanoptera, constituted of the Linnæan genus Thrips, minute insects well known to gardeners, differ from the Coleoptera in the nature of their metamorphoses, in which they resemble the Orthoptera and Hemiptera. The structure of the wings and mouthparts, however, are considered to exclude them from these two orders.

The Trichoptera, or Caddis worms, offer many points of resemblance to the Neuroptera, while in others they approach more nearly to the Lepidoptera. According to Westwood, the genus Phryganea "forms the connecting link between the Neuroptera and Lepidoptera."

The last of these small aberrant orders is that of the Aphaniptera, constituted of the family Pulicidæ. In their transformations, as in many other respects, they closely resemble the Diptera. Strauss Durckheim indeed said that "*la puce est un diptère sans ailes.*" Westwood, however, regards it as constituting a separate order.

As indicated by the names of these orders, the structure of the wings affords extremely natural and convenient characters, by which the various groups may be distinguished from one another. The mouth-parts also are very important; and, regarded from this point of view, the Insecta may be divided into two series—the Mandibulata and Haustellata, or mandibulate and suctorial groups, between which, as I have already shown,* the Collembola (Podura, Smynthurus, &c.), occupy an intermediate position. These two series would stand as follows :—

Mandibulata	*Haustellata*
Hymenoptera	Lepidoptera
Strepsiptera	Diptera
Coleoptera	Aphaniptera
Euplexoptera	Hemiptera
Orthoptera	Homoptera
Trichoptera ?	
Thysanoptera ?	

Again, and this is the most important from my present point of view, insects have sometimes been divided into two other series, according to the nature of the metamorphoses: Heteromorpha, to use the terminology of Prof. Westwood,* "or those in which there is no resemblance between the parent and the offspring and Homomorpha, or those in which the larva resembles the imago, except in the absence of wings. In the former the larva is generally worm-like and articulated in its form, of a soft and fleshy consistence, and furnished with a mouth, and often with six short legs attached in pairs to the three segments

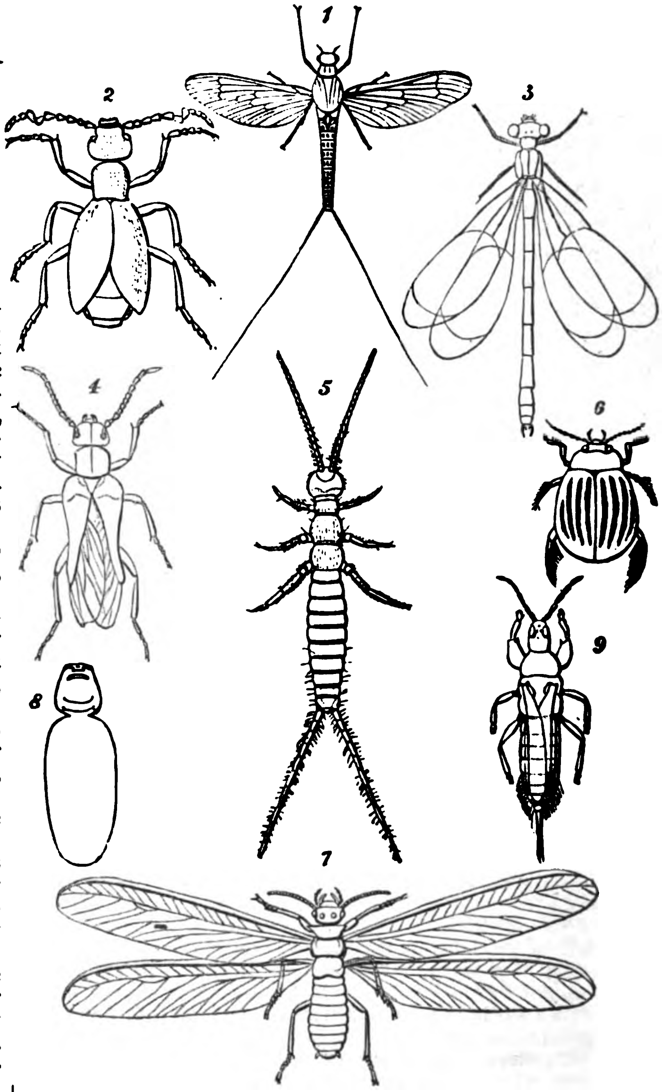

PLATE 3

PL. 3.—FIG. 1, Chloeon. 2, Meloe (after Shuckard). 3, Calepteryx 4, Sitaris (after Shuckard). 5, Campodea (after Gervais). 6, Acilius 7, Termes. 8, Stylops (female). 9, Thrips.

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* Linnæan Journal, vol. xi.

* Introduction to the modern Classification of Insects, p. 17.

succeeding the head. In the latter, including the Orthoptera, Hemiptera, Homoptera, and certain Neuroptera, the body, legs, and antennæ are nearly similar in their form to those of the perfect insect, but the wings are wanting."

Heteromorpha	*Homomorpha*
Hymenoptera	Euplexoptera
Strepsiptera	Orthoptera
Coleoptera	Hemiptera
Trichoptera	Homoptera
Diptera	Thysanoptera
Aphaniptera	
Lepidoptera	

Neuroptera

But though the Homomorphic insects do not pass through such striking changes of form as those belonging to the other series, and are active throughout life, still it was until within the last few years generally (though erroneously) considered that in them, as in the Heteromorpha, the life fell into four distinct periods ; those of (1) the egg, (2) the larva characterised by the absence of wings, (3) the pupa with imperfect wings, and (4) the imago or perfect insect.

I have, however, elsewhere * shown that there are not, as a matter of fact, four well-marked stages, and four only, but that in many cases the process is much more gradual.

The Hymenoptera are among the most interesting of insects. To this order belong the gallflies, the sawflies, the ichneumons, and above all, the ants and bees. We are accustomed to class the Anthropoid apes next to man in the scale of creation, but if we are to judge animals by their works, the chimpanzee and the gorilla must certainly give place to the bee and to the ant. The larvæ of the sawflies, which live on leaves, and of the Sirecidæ or long-tailed wasps, which feed on wood, are very much like caterpillars, having three pairs of legs, and in the former case abdominal prolegs as well ; but in the great majority of Hymenoptera the larvæ are legless, fleshy grubs (Plate 2, Figs. 7-9) ; and the various modes by which the females provide for or secure them a sufficient supply of appropriate nourishment, constitutes one of the most interesting pages of Natural History.

The pupæ are inactive, and show distinctly all the limbs of the perfect insect, encased in distinct sheaths, and folded on the breast.

In the perfect state these insects are highly organised and very active. The working ants and some few species are wingless, but the great majority have four strong membranous wings, a character distinguishing them at once from the true flies, which have only one pair of wings. The species of Hymenoptera are very numerous ; in this country alone there are about 3,000 kinds, most of which are very small.

The sawflies are so called because they possess at the end of the body a curious organ, corresponding to the sting of a wasp, but which is in the form of a fine-toothed saw. With this instrument the female sawfly cuts a slit in the stem or leaf of a plant, into which she introduces her egg.

The larva much resembles a caterpillar, both in form and habits. To this group belongs the nigger, or black caterpillar of the turnip, which is often in sufficient numbers to do much mischief. Some species of this group make galls, but the greater number of galls are formed by insects of another family, the Cynipidæ (Plate 1, Fig. 7). In this family the female is provided with an organ corresponding to the saw of the sawfly, but resembling a needle. With this she stings or punctures the surface of leaves, buds, stalks, or even roots of various plants. In the wound thus produced she lays one or more eggs. The effects of this proceeding, and particularly of the irritating fluid which she injects into the wound, is to produce a tumour or gall, within which th egg hatches, and on which the larva, a thick fleshy gru (Plate 2, Fig. 7) feeds. In some species each gall co tains a single larva ; in others, several live together. Th oak supports several kinds of gallflies ; one forms the wel known oakapple, one forms a small swelling on the le resembling a currant, another produces a gall somewh resembling an acorn, another attacks the root ; the speci making those bullet-like galls, which are now so commo has only existed for a few years in this country; th beautiful little spangles so common in autumn on th under side of oak-leaves are the work of another species the *Cynips longipennis*. When the larva is full grown, i eats through the gall, falls to the earth, and turns into a chrysalis. One curious point about this group is, that i some of the commonest species the females alone ar known, no one yet having ever succeeded in finding a male.

Another great group of the Hymenoptera is that of the ichneumons ; the females lay their eggs either in or o other insects, within the bodies of which the larvæ li They are thick, fleshy, legless grubs, and feed on the fatty tissues of their hosts, but do not attack the vi organs. When full grown, they eat their way through the skin of the insect, and turn into chrysalides. Almost every kind of insect is subject to the attacks of these horrid little creatures, which, however, are no doubt useful in preventing the too great multiplication of insects and especially of caterpillars. Some species are so minute that they even lay their eggs within those of other insects. The larvæ of these genera assume very curious forms.

But of all Hymenoptera, the group containing the ant, the bee, and the wasp is the most interesting. This is especially the case with the social species, though the solitary ones also are extremely remarkable. The solitary bee or wasp, for instance, forms a cell generally in the ground, places in it a sufficient amount of food, lays an egg, and closes it up. In the case of bees, the food consists of honey ; in that of wasps, the larva requires animal food, and the mother therefore places a certain number of insects in the cell, each species having its own special prey, some selecting small caterpillars, some beetles some spiders. *Cerceris bupresticida*, as its name denotes, attacks beetles belonging to the genus Buprestis. Now if the Cerceris were to kill the beetle before placing it in the cell, it would decay, and the young larva when hatched would find only a mass of corruption. On the other hand, if the beetle were buried uninjured, in its struggles to escape it would be almost certain to destroy the egg. The wasp has, however, the curious instinct of stinging its prey just in the centre of the nervous system, thus depriving it of motion, and let us hope of suffering, but not killing it ; when, therefore, the young larva leaves the egg, it finds ready a sufficient store of wholesome food. Other wasps, like the bees and ants are social, and dwell together in communities. They live for one season, dying in autumn, except some of the females, which hybernate, awaking in the spring and forming new colonies. Even these, however, under ordinary circumstances, never live through a second winter. One specimen which I kept tame through last spring and summer, lived until the end of February, but then died. The larvæ of wasps are fat, fleshy, legless grubs. When they are full grown they spin for themselves a silken covering, within which they turn into chrysales. The oval bodies which are so numerous in ants' nests, and which ar generally called ants' eggs, are really cocoons, no eggs. Ants are very fond of the honey-dew which i formed by the Aphides, and have been seen to tap th Aphides with their antennæ, as if to induce them t emit some of the sweet secretion. There is a species o Aphis, which lives on the roots of grass, and some ant collect these into their nests, keeping them, in fact, jus as we do cows. One species of red ant does no work for itself, but makes slaves of a black kind, which then do everything for its masters.

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* Linnæan Transactions, 1863—" On the Development of Chloeon."

Ants also keep a variety of beetles and other insects in their nests. That they have some reason for this seems clear, because they readily attack any unwelcome intruder; but what that reason is we do not yet know. If these insects are to be regarded as the domestic animals of the ants, then we must admit that the ants possess more domestic animals than we do. But on this and many other points connected with ants we require additional information.

The Strepsiptera are a small, but very remarkable group of insects, parasitic on bees and wasps. The larva (Pl. 4, Fig. 8) is very minute, six-legged, and very active; it passes through its transformations within the body of the bee or wasp. The male and female are very dissimilar. The males are minute, very active, short-lived, and excitable, with one pair of very large membranous wings. The females (Pl. 3, Fig. 8), on the contrary, are almost motionless, and shaped very much like a bottle; they never quit the body of the bee, but only thrust out the head of the bottle between the abdominal rings of the bee.

JOHN LUBBOCK

(*To be continued.*)

COTOPAXI—THE FIRST ASCENT OF THE GREAT VOLCANO[*]

STANDING fifty miles below the equator, and a hundred west of the meridian of Washington, Cotopaxi is at once the most beautiful and the most terrible of volcanoes. From the valley of Quito it appears like a huge truncated cone, in altitude equal to five Vesuviuses piled upon each other, its summit rising 4,000 ft. above the limit of perpetual snow, its sides presenting alternate ridges and gorges ploughed by descending floods of water, and around the base for miles heaps of ruins—boulders 20 ft. square, and volcanic ashes and mud 600 ft. deep. Very seldom does Cotopaxi wake up to intense activity, for as a rule the higher a volcano the less frequent its eruptions. Generally the only signs of life are the deep rumbling thunders and a cloud of smoke lazily issuing from the crater.

On November 27, 1872, Dr. Reiss—a German naturalist, who, with Dr. Stubel, has been exploring the Valley of Quito during the last forty years—set out from Mulolo with ten peones for the south-west point of the crater. Crossing the river Cutuche at Limpiopungo, where the stream cuts through vast deposits of volcanic ashes, he reached the "Ventanillas," a dry and sterile pampa, since the porous earth retains no moisture. Here the ascent of the cone began. Following the triangular ridge that divides the deep defiles of Manzanaguaico and Pucahuaico, and whose apex reaches the snow limit, he crossed subordinate cerros and pampas, which are so many steps in the grand staircase he was ascending. Vegetation now ceased entirely, and the surface was covered with ashes and black sand. In fact, nearly the whole occidental slope of Cotopaxi, between 12,500 and 16,000 ft., presents the aspect of a dismal black desert. Progress was slow, for at every step the foot sank into the sand, which increased in depth with the ascent.

Suddenly a profound chasm, containing fresh, smoking lava, was discovered on the left. This lava-stream was the lower limit of a vast mass, which from the valley appeared like a long black line. At 2 P.M. our traveller reached the point where the two quebradas unite, marked by an immense pile of rocks. Here he encamped for the night at an altitude of 15,179 feet.

An immense stream of lava came down the cone, and near the place of encampment divided, entering the two quebradas or ravines mentioned. The lava was still warm, clouds of vapour rising along the whole extent of the stream. During the afternoon the thermometer had stood at freezing point; but in the night it fell to twenty-five degrees.

The next day Dr. Reiss attained all his hopes. Cropping out of the lava stream, but mainly disposed along the borders of it, were numerous rough stones, upon which he advanced as on the rounds of a ladder. The greatest width of the lava current before it divided was about 3,000 ft., and the estimated thickness 150 ft. The lava was entirely black and warm in all its course; its temperature being from 68° to 91°, while that of the atmosphere was 32°. This elevated temperature explains the absence of snow on this part of the slope. The gaseous exhalations from the crevices seemed to be nothing more than air mixed with vapour. This is doubtless the lava-stream which flowed in 1854, and which, by melting vast quantities of snow, caused much devastation in the valley by floods. No fissure or accumulation of scoriæ indicates the source of the lava-stream; but the altitude of the point of departure is 18,700 feet.

At 8.45 he reached the arenal, a deep mass of fine sand stretching upward at an angle of 40°. Over this he must advance, difficult as it was, for on either side were impassable fields of snow and ice. The temperature of the sand was 77°. Another stream of lava was discovered, which must have flowed with great velocity, since, instead of following the inclination of the cone, it had descended diagonally. Only the peaks of Iliniza and Chimborazo in the opposite Cordillera were visible; but above the clouds, towards the south-west, a dense mass of smoke rose perpendicularly to a prodigious height, and then by an east wind was carried off in a horizontal line westward. This came from the furious and ever-active volcano of Sangay, whose top was invisible, but whose activity was manifested in this manner. As the clouds shifted, the diversified valley and its royal mountains were spread out like a map.

It was now 10.15 A.M.; thermometer, 28°. Fumeroles abounded, giving forth sulphurous gas. And now followed a sheet of compact blue ice, inclined from 35° to 40°; but fortunately it was not smooth, but covered with myriads of points or icicles three or four inches high. Scrambling over this, and climbing over and between walls, some of immense size, suddenly Dr. Reiss reached the edge of the crater. He had reached the western part of the southern lip. The crater presented an elliptical form, the major axis lying north and south. The stones which were continually falling in from all sides, but especially from the west side, rolled together as to the bottom of a funnel; there were no signs of a level bottom. The depth, roughly estimated, appeared to be 1,500 ft. The side of the funnel least inclined, and by which alone it is possible to descend, is the south-west; but here are large fumeroles sending forth dense masses of vapour charged with gas, and having a temperature of 156°. Around these fumeroles were masses of sulphur and a deposit of gypsum mixed with chloride of lime. This is of great interest as being the first instance of a chloride being found among the products of the South American volcanoes. Humboldt thought that the absence of hydrochloric acid was a characteristic of the New World volcanoes. The barometer gave 19,660 ft. as the altitude, while the doctor's trigonometrical observations, repeated at various times from independent bases in the valley, had given him 19,496 ft. as the height of the north peak, and 19,427 ft. for the southern. Both results exceed the altitude estimated by other travellers. Humboldt made it 18,880 ft.

Dr. Reiss left the crater at 1.45 P.M., and reached his encampment at the head of the ridge in three hours and a half, just as a heavy snow-storm began. He says he felt no inconvenience from the rarefaction of the air.

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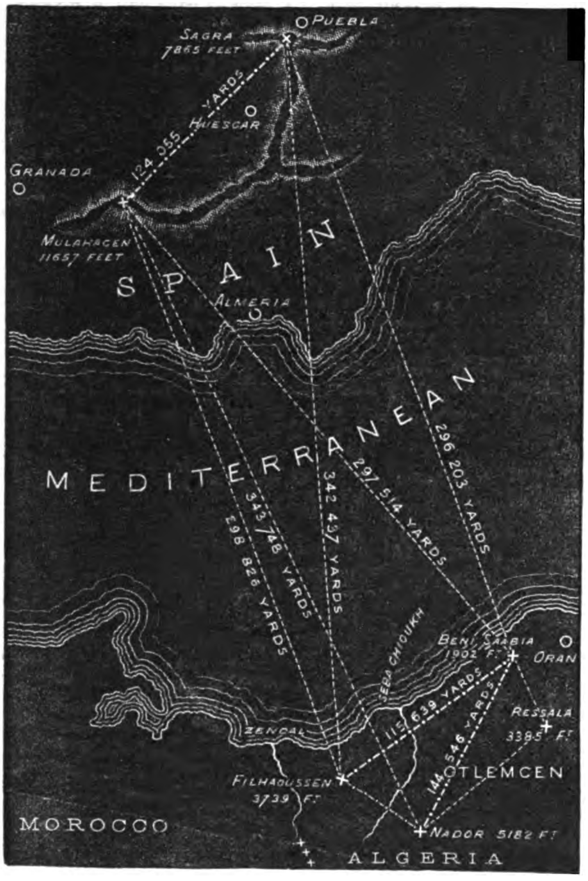
[*] Abstract of an article by Mr. James Orton in the New York *Evening Post*, March 12, 1873.

CAPTAIN PERRIER'S GEODETIC OPERATIONS IN ALGERIA

THE idea of prolonging the French arc of meridian to Sahara by the direct trigonometrical junction of Spain and Algeria, an idea of undoubted scientific value, presented itself to the mind of Captain Perrier when he was collecting the preliminary materials for the survey of Algeria. That survey was begun at the same time as the conquest, in the middle of military operations.

The design was to calculate two great lines conforming to parallels, and transversely cut by three meridians; quadilaterals would be thus formed, completed by triangles of the first order. Only a linear chain was however drawn, except in the mountainous regions where the operations would have been attended with too many difficulties.



Map showing prolongation of Meridians from Spain to Algeria

This chain, connected with the sea by three excellent bases, would serve the purpose of adjusting and arranging the detailed operations. French geodesy thus measured an arc of latitude cutting the Paris meridian and extending from Morocco to Tunis, with a length of 990 kilometres.

The chain of first-order triangles may be divided into two parts, the first from Blidah to Tunis, measured by Captain Versigny, the other more recent measured by Captain Perrier.

The admirable choice of triangles, stations, and signals is noteworthy. Those signals have been built by the observers themselves, as there were no steeples. The precision obtained is remarkable. In the sum of the three angles of any triangle, the error is about 3″·12 (centesimal seconds) [*] in M. Versigny's operations (who made use of Gambey's repeating circles); the error is about 3″·07 in M. Perrier's operations, who made use of Brunner's excellent asimuthal circles. In order to measure the bases, the system of M. Porro, an Italian engineer, has been employed, in preference to the old method of Borda, and it has been followed by the best results.

Colonel Levret proved (in 1869), by very exact calculations, that the passage by Gibraltar could be dispensed with, and that it would be possible to communicate between Spain and Algeria, in spite of the immense distance between the two continents. The entire certainty of that possibility has been proved by Captain Perrier, who has pointed out in a precise manner the names and positions of the visible summits and the length of the sides of the new chain.

It was only on October 18, 1868, that he managed to perceive the Spanish shore: he saw it from Seba Chioukh, near the mouth of the Tafna, very distinctly and without the glass. A serrated ridge was to be seen in the distance, toward the north-west, with five prominent summits. The distinctness was so perfect, that he could discern with his naked eyes the different parts of those mountains, those which were in the shade and those illuminated by the sun. He thus measured azimuths with the summit of the Tessala, the zenithal distances of the two highest points of the ridge, and the zenithal distance of the horizon of the sea.

After his return to France, he compared his measurements with the survey of Spain, made by Colonel Cuello, and concluded that he had observed the Mulahacen of the Sierra Nevada, and the peak of Sagra of the Sierra Sagra, the highest points of the Sierras of the Province of Granada.

In Spain the peaks of Sagra can be seen from Mulahacen; those mountains belong to the primordial geodetic chains of the Iberic peninsula. In Africa the points of the quadrilateral (Bem Saabia, Tessala, Filhaoussen, and Nador) are reciprocally visible, and the three last are situated in the primordial chain of Algeria.

With these points, Captain Perrier was enabled to form a chain common to Europe and Africa. Leaving the station of Seba Chioukh as superfluous, as well as the direction of Nador-Sagra as being too close to the horizon of the sea, he delineated that immense pentagon formed by the five summits of Mulahacen, Sagra, Bem Saabia, Filhaoussen, and Nador, every side and diagonal of which, except one, are the directions that are to be observed. He has even calculated and valued in round numbers the length of the sides of this geodetic chain. He has found—

	Metres.
Mulahacen-Filhaoussen .	273,400
„ Nador . . .	314,500
„ Bem Saabia .	272,200
Sagra-Filhaoussen . . .	313,300
„ Bem Saabia . .	271,000

The length of the terrestrial sides are—

	Metres.
Bem Saabia-Filhaoussen .	109,800
„ Nador . . .	104,800
Mulahacen-Sagra . . .	113,900

With those approximate numbers (and valuing at 0·08 the coefficient of refraction) he has calculated the altitudes of the two Spanish mountains. The measures thus obtained differ little from the real numbers—

	Metres.
Mulahacen	3,994
Sagra	2,398

given by Colonel Cuello, and thus furnish a new verification.

As the geodetic operations are being continued with great activity in Spain and in Algeria, we may hope that in a few years the geodetic bases of Great Britain, of France, Spain, and Algeria, reduced to the same unit of measure, can be connected by continual chains of triangles; and the meridian line of France already prolonged northward to the Shetland Islands, carried out in Spain by the officers of that country, will reach the African Continent and extend to the Sahara, with a length of 30°.

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[*] One centesimal second = 0′·33 ordinary second.

France will then be able to oppose to the Russian arc and to the one measured in Central Europe the French arc, which, passing over plains and very high mountains, will cross the North Sea and the Mediterranean.

There is thus considerable truth in the words of M. Faye:—"Let us not forget that the French, who are at the present time so often reproached with their geographical ignorance, are the real creators of continental or maritime geodesy, and that they have continually, since Cassini to our days, published admirable geodetic papers, which have served as models to our rivals; the truly learned men abroad have always acknowledged their value."

The map of Algeria will be constructed on the same plan as the map of France, to the scale of $\frac{1}{80000}$, but as it will be coloured, and as level curves will be substituted for hatchings, it will have considerable advantages over the latter.

M. CORNU

NOTES

THE French *Société d'encouragement* have awarded to Sir Charles Wheatstone, F.R.S., the Ampère medal for his remarkable works in theoretic and applied physics. The grand prize of 12,000 francs for the discovery most useful to French industry has been awarded to M. Pasteur, for the improvements he has introduced into the manufacture of silk, of wines, of vinegar, and of beer. A prize of 3,000 francs has been awarded to M. Gramme for the construction of an apparatus giving an electric current constant in direction and in intensity, whose electromotive force and conductibility are equal to those of an azotic acid pile of 60 or 80 elements of ordinary size, and superior both in economy and solubility to the apparatus which are at present in use.

AT the present time there are staying in England two illustrious physiologists, Prof. Kölliker and Prof. Fick, the former the renowned head of the Histological School, and the latter of the Physiological Institute in the University of Würzburg.

THE University of Cambridge has accepted a fund raised by several members of St. John's College for the purpose of founding a prize to be called the Adams Prize, for the best essay on some subject of pure mathematics, astronomy, or other branch of natural philosophy. The prize is to be given once in two years, and to be open to the competition of all persons who have at any time been admitted to a degree in the University. The examiners have given notice that the subject for the prize to be adjudged in 1875 is a Theory of the Reflection and Refraction of Light.

BY the present monthly mail a testimonial, consisting of a silver tea and coffee service, is being sent to Dr. Kirk at Zanzibar, by the Royal Geographical Society. The inscription states that it is given in recognition of the services Dr. Kirk has rendered to his country and to science by his generosity, intelligence, and zeal in the advancement of African discovery.

MR. A. H. GARROD, B.A., has been appointed Lecturer on Zoology and Comparative Anatomy at the Charing Cross Hospital. Mr. Garrod, we believe, intends to give a course of lectures during the summer.

AT the general monthly meeting of the Royal Institution of Great Britain, on Monday, April 7, the special thanks of the members were returned to Dr. Warren De La Rue, for his donation of 100*l*. towards the expense of fitting up the new Laboratories.

THE Report to the Board of Visitors of the Astronomer Royal for Scotland, gives a satisfactory account of the work, astronomical and meteorological, done at the Royal Observatory, Edinburgh. The alterations in the observatory have been completed, and the new equatorial, referred to in NATURE some months ago, is nearly ready for use, though we are sorry to see that its efficient working is very likely to be marred from want of funds. Though much needed for various purposes, Government (with a surplus of nearly five millions!) have absolutely refused to grant any additional aid to the Edinburgh Observatory. Prof. Piazzi Smyth compares his position to that of an "unfortunate artillery officer who should have received a big gun, of perhaps the most approved wrought iron and steel construction in itself, but without means of moving it, without powder and shot; and yet should be expected by the public to be continually firing it with immense success and at all sorts of objects throughout the whole year."

WITH reference to the sum of 500*l*. placed at the disposal of the Council of the Society of Arts, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—The Society's Gold Medal and Fifty Pounds. 2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. 3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—The Society's Gold Medal and Fifty Pounds. 4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. 5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—The Society's Gold Medal and Fifty Pounds.

WE understand that the scientific authorities at Berlin are preparing a manual containing the necessary information for the requirements of the various expeditions sent out by the Imperial Government to observe the transit of Venus. The information given will by no means be confined to astronomical and physical subjects, but will incorporate all the branches of natural history. We hope our Government will follow so excellent a precedent, and associate a certain number of naturalists along with the astronomical observers, especially in situations where their observations are likely to prove of value.

THE forty tanks in the Brighton Aquarium, under Mr. Savile Kent's superintendence, are now well stocked with fishes, and present a most interesting field of study to the Ichthyologist. Eight of them are devoted to fresh-water fishes, and the remaining to the marine forms. Amongst the latter are fine specimens of the herring, lump-sucker, grey, streaked and red gurnets, sting-ray, balan wrasse, cook and cork-wing wrasses, and gold-sinny. Two species of dogfish have deposited eggs in their tanks, and the embryos are in process of development. The most recent addition to the fresh-water fishes is a fine salmon, presented by Mr. Berridge, Chairman of the Usk Fisheries. The two porpoises are in excellent health, and feed well on smelts and small whitings. The large tank, 100 feet in length, and containing 110,000 gallons of sea-water, gives them ample space for their gyrations.

On Saturday afternoon last Professor Ansted was thrown with so much violence from a low basket phaeton in which he and another gentleman were driving, near Melton, that his thigh was broken, and a severe scalp wound inflicted. After being attended to by a doctor, he was removed to his house at Melton. Hopes of his recovery are entertained.

On Saturday last Canon Greenwell, of Durham Cathedral, and Professor Rolleston, of Oxford, completed a series of very interesting excavations among the ancient barrows which exist in the Goodmanham and Etton Wolds, near Beverley, Yorkshire. There is a singular absence in these barrows of the implements so frequently found with ancient human remains in many parts of the country. Not only in the present excavations, but in those formerly instituted by Lord Londesborough, implements usually associated with ancient interments are entirely wanting. Contrary also to the generality of the barrows found on the wolds, which contain chiefly unburnt remains, in this locality they are for the most part burnt. Although this part of the country seems to have been extensively peopled, as these sepulchral remains betoken, there is a singular absence of implements, whereas in the north and middle wolds flint implements are found scattered about in all directions. Stone axes and other rude implements are abundant in the rest of the wold district, but they seem to have been entirely unknown in this locality, as many persons have searched for such remains without result.

The Geographical Society of St. Petersburg has lately undertaken a new exploration of Russian territory in addition to those already carried on under its auspices. The plan consists in a minute exploration, under the leadership of M. Tschekanowsky, of the area between the lower affluents of the Yenisei and the Lena, embracing the basin of the river Olenek, which represents an important deficiency in the known portion of Eastern Siberia. Two years will be occupied in the exploration. During the first the expedition will descend the Lower Tunguska, and will reach Irkutsk by the Yenisei. During the second year it expects to reach the sources of the Olenek by sledges, to descend that river to its mouth, and then cross over to the Lena, and return by this river to Irkutsk.

Those who are interested in the mental advancement of women, should refer to the March number of the *American Naturalist*, in which they will find that the first article, on "Controlling sex in butterflies," is written by Mrs. Mary Treat. This lady has prosecuted her inquiries in a truly scientific spirit, and she records her results with the greatest precision and accuracy. An outline of her argument will be found in our notice of the periodical in which it appears.

Dr. Brown-Sequard has started a new journal, the *Archives of Scientific and Practical Medicine*, published at New York and London on the 15th of each month. His sub-editor is Dr. E. C. Seguin. This periodical will chiefly contain original papers on subjects belonging to every branch of the medical sciences. It will also comprise *résumés* of English and foreign papers, reports from the author's laboratory, and reviews of modern works on kindred subjects. The first number for January, which is beautifully printed, contains 100 pages, with one plate. In it Dr. Brown-Sequard contributes a paper on "Effects of Injuries of Nerves," and there are others by Dr. Seguin, Mr. Dupuy, Dr. Sands, Dr. Mary Putnam, and several able medical authors.

Petermann's *Mittheilungen* thus speaks of the refusal of Government to grant an Arctic expedition this year:—"England, with her enormous wealth, her multitude of ships, sailors, and facilities for equipment, but above all with her great experience, could easily have sent out such an expedition, and with more prospect of success than any other nation; but the English Government, which appears to carry parsimony further than any other, has refused the request, at least for this year. But it is to be hoped that the undertaking, for which Government was also petitioned in 1865, will at last be afloat in 1874."

At the meeting of the French Academy last week, M. Jamin exhibited a magnet which he had constructed to carry upwards of twenty-two times its own weight: it weighs 2 kilogrammes and carries 45. Hitherto the greatest carrying power attained in artificial magnets has been from four to five times their own weight. M. Jamin has obtained this unprecedented result by substituting for the very thick plates hitherto employed, a sufficient number of very thin plates superposed on each other, and all thoroughly magnetised. One result of this achievement will be that the volume and weight of magneto-electric machines can now be diminished to a very great extent.

A very full notion of the rapid material progress of Victoria in almost every direction may be obtained from the Official Catalogue of Exhibits of the Victoria Exhibition, opened at Melbourne in Nov., 1872. The entries number 1,682, and though there are very few connected directly with science, it would be unjust to form from this fact a low estimate of the progress made in scientific discovery by the colony; an investigation of the entries in the various departments shows that the principles of science have been abundantly taken advantage of in them all. It is gratifying to find, from the patent statistics, that every year shows an increase in the number of inventions connected with agriculture and manufactures, while the mining resources of the country continue to occupy a large share of the attention of inventors. The compiler of the catalogue claims with justice that Victoria has contributed a considerable amount of valuable data to various departments of science. Appended to the catalogue is an interesting essay on "Mining and Mineral Statistics, with Notes on the Rock Formations of Victoria," by Mr. R. Brough Smyth, F.G.S., Secretary for Mines for Victoria. A preliminary note gives some satisfactory statistics as to the progress of the Industrial and Technological Museum of Melbourne, which was opened in September 1870.

The *Australian Mechanic*, in an article on "Science in the South," thinks "there is good reason for hoping that the time is rapidly advancing when even in Australia the enthusiasm of science will become a wide-spread sentiment, and when a deep and genuine interest will be taken in questions of a purely abstract kind." The *Mechanic* thinks it possible that ere long the Australians "may have the satisfaction of hearing a Tyndall, a Huxley, an Owen, and their worthy fellow-labourers expounding to delighted audiences in the Melbourne Athenæum, 'the fairy tales of science.'"

The first number of *Cosmos*, the new Italian geographical journal, is handsome and well printed, and the contents creditable. There is a long article on recent expeditions to New Guinea, illustrated by a well-constructed map; and, of course, another long article on African exploration, also accompanied by a map. Another longish article is the first of a series on the Russian possessions in Central Asia. Altogether the first number of *Cosmos* is satisfactory, and we wish it a long career and a wide circulation.

The Italian Geographical Society, by a unanimous vote, has conferred upon the Commendatore Negri Christoforo, who has so long and so perseveringly promoted geographical science among his countrymen, the title of perpetual president of the Society.

Messrs. Chapman and Hall have sent us an elaborately constructed but perfectly intelligible "Table of British Strata," showing their order of superposition and relative thickness. Although the division into systems, series, and formations are very detailed, the size of the chart is such, and the use of colours is so judicious, that there is little danger of it causing perplexity and confusion to the young student; the plan seems to us admirably clear and useful, and the table is in the highest degree creditable to its constructor, Mr. H. W. Bristow, F.R.S., F.G.S., director of the Geological Survey of England and Wales. It is intended for the use of schools, but we are sure it will be welcomed by many geological students who have long left school.

M. Felix Plateau describes in *Les Mondes*, an ingenious process, of his own invention, for drawing on paper white lines on a black ground—a method so frequently used for scientific illustrations—by means of which both author and artist will be able to judge of the effect of such an illustration before putting it into the hands of the engraver. A piece of thickish paper, as smooth as possible, a little larger than the intended illustration, is heated, say by laying it, with proper precautions against being injured, on the top of a stove, and a piece of bees-wax is rubbed over it until the paper is completely covered with a thin coating. A piece of glass, the size of the paper, is blackened by being held over a candle, and when thoroughly cooled it is laid on the waxed paper and rubbed firmly with the fingers, the result being that a blackened surface is produced on the paper, on which any design can be traced with a needle for the finer lines, or the back of a steel-pen for the thicker ones.

A great international horticultural exhibition is to be held at the Alexandra Palace on May 24 and five following days, on the occasion of the palace being opened to the public.

General Comstock's "Annual Report of the Survey of the North and North-Western Lakes" of America for the year ending June 1872, contains the results of much well-planned and thoroughly well-performed work. A well-constructed map illustrates the many typographical and hydrographical data. One point we may mention is that General Comstock has come to the conclusion, as the results of several years' observations, that the moon and sun undoubtedly cause tides in Lake Michigan, though the rise of level is very small indeed; the combination of the two at syzigies giving a tide somewhat less than 0·12 of a foot.

Dr. B. W. Richardson, F.R.S., has been elected by the President and Council of the Royal Society, Croonian Lecturer on the subject of muscular motion.

Among the Candidates for the professorship of Anatomy to the Royal Academy are Dr. B. W. Richardson, F.R.S., and Mr. John Marshall, F.R.S.

The *Academy* understands that Mr. Moggridge, author of "Harvesting Ants and Trap-door Spiders," recently reviewed in Nature, has deposited specimens of the animals and their nests in the British Museum, and that they are exhibited in one of the public galleries.

The additions to the Zoological Society's Gardens during the last week include a black Cuckoo (*Endynamys sp?*) from Madagascar, and a Seychellean Sternothere (*Sternothaera subniger*) from the Seychelles, presented by Commissioner H. C. St. John; four Spanish Terrapins (*Clemmys leprosa*), and six Greek land-tortoises (*Testudo græca*) from Morocco, presented by Sir J. Drummond Hay, K.C.B.: a Vulpine Squirrel (*Sciurus vulpinus var capistratus*) from S. America, presented by Mr. G. Moore; a Barbary Ape (*Macacus inuus*) from N. Africa, deposited by Lord Calthorpe; three Barbary Sheep (*Ovis tragelaphus*) born in the Gardens; a De Filippi's Meadow Starling (*Sturnella defilippi*) from Rio de la Plata, and a Black Kite (*Milvus migrans*), European, purchased; and two variegated Touracons (*Schirorhis africana*) from W. Africa, received in exchange.

PREHISTORIC CULTURE OF FLAX

Dr. Oswald Heer, the eminent botanist, and one who has devoted so much attention to the structure and history of fossil plants, publishes an article upon flax and its culture among the ancients, especially the prehistoric races of Europe. His memoir may be summarised as follows: First, flax has been cultivated in Egypt for five thousand years, and that it was and is one of the most generally diffused plants of that country. It occupied a similar position in ancient Babylonia, in Palestine, and on the Black Sea. It occurred in Greece during the prehistoric period, and at an early date was carried into Italy, while its cultivation in Spain was probably originated by the Phœnicians and Carthaginians. Second, it is also met with in the oldest Swiss lacustrine villages, while, at the same time, no hemp nor fabrics manufactured from wool are there to be found. This is considered a remarkable fact, since the sheep was one of the oldest domestic animals, and was known during the stone period. The impossibility of shearing the fleece by means of stone or bone implements is supposed to have been the reason why woollen fabrics were not used. It is thought probable that the skin, with its attached wool, was probably made use of for articles of clothing. Third, the lake dwellers probably received flax from Southern Europe, from which section fresh seeds must have been derived from time to time. The variety cultivated was the small, native, narrow-leaved kind from the coast of the Mediterranean, and not at all that now raised in Europe. It must, therefore, have been cultivated also in Southern Europe, although Dr. Heer could not ascertain among what people and at what age this took place. If this could be ascertained it would be an important point in the determination of the antiquity of the lake dwellers. Fourth, at the time of the empire both summer flax and winter flax were cultivated in Italy, as now, but in what form it was grown in ancient Egypt is not determined. It is thought probable that the narrow-leaved variety was first introduced, and after that the Roman, and then the common varieties followed. The common plant has doubtless arisen from the cultivation of the narrow-leaved, while the Roman winter flax and the *Linum ambiguum* constitute the intermediate stages. The original home of the cultivated flax was therefore along the shores of the Mediterranean. The Egyptians had probably cultivated it, and from them its use was doubtless disseminated. It is possible that the wild variety and the winter flax were grown elsewhere at the same time, when the cultivated variety had long since driven them out of use in Egypt.

SCIENTIFIC SERIALS

In the *Journal of Botany* for February Dr. Trimen describes one of the most interesting additions recently made to the British flora, *Juncus pygmæus*, a well-known European species, discovered by Mr. W. H. Beeby in the already very rich locality of Kynance Cove, Cornwall. The article is accompanied by a good drawing. Mr. J. G. Baker gives a description of the little known *Rosa appennina*. In geographical botany Dr. W. M. Hind contributes a list of plants of North Cornwall. Mr. W. Phillips's notes on the blue reaction given by iodine in certain fungi may furnish a useful discrimination of difficult species. In the March number Mr. Worthington Smith gives a description, with coloured plate, of several new Hymenomycetous fungi from stoves; and Mr. J. A. Lees a useful paper on the peculiarities of plant-distribution in the neighbourhood of Leeds. Dr. H. F. Hance has an article on the "Ch'ing Muh Hsiang" or "Green Putchuk" of the Chinese, derived from a species of Aristolochia, the paper being illustrated by a copy of a native drawing. In both these numbers are also a variety of selected articles, short notes, and memoranda. We are glad to see this interesting journal taking so increasingly useful a place among our scientific periodicals.

Among the numerous articles of interest in the *Scottish Naturalist* for January (commencing the 2nd volume) we may single out especially, "On the occurrence of the hooded seal (*Cystophora cristata*) at St. Andrews," by Mr. R. Walker; a commencement of an article on Scottish gall-making insects, by Mr. P. Cameron, jun., illustrated by a beautiful coloured plate of *Nematus gallicola*; and a paper on the recent remarkable abundance of *Vanessa Antiopa*, the "Camberwell beauty," in this country, by the editor, who sums up strongly in favour of the native rather than the foreign origin of the insects captured in this country last year. We have also a continuation of the "Insecta Scotica," in instalments of the Lepidoptera of Scotland, by Dr. Buchanan White, and the Coleoptera of Scotland, by Dr. D. Sharp.

THE *Journal* of the Royal Geological Society of Ireland, vol. iii. part 2, N. S. (vol. xiii. part 2) contains:—Reply to the observations in Mr. Kinahan's paper "On the Carboniferous Rocks of Iceland," by Prof. Ed. Hull, F.R.S. (Abstract); On *Phaneropleuron Andersoni* (Huxley) and *Uronemus lobatus* (Agas.), by Prof. Traquair, M.D. (plate v.); Additional Notes on the fossil Flora of Iceland; On *Filicites plumiformis* (Baily) from carboniferous limestone near Wexford, by W. H. Baily (plate vi.); Notes on the Carrara marble quarries, by Prof. E. Hull; On a remarkable fault in the New Red sandstone of Rainhill, Lancashire; and observations on the results determined by the Royal Commission into the Coal Resources of Great Britain and Ireland, by Prof. E. Hull; Sketch of the physical geology of North Clare, by W. H. S. Westropp; On tertiary iron ore in the County of Londonderry, by G. H. Kinahan; and Notes on Woodwardite, by Prof. J. E. Reynolds.

THE *Monthly Microscopical Journal* for April is an excellent number, containing several valuable papers. Mr. Wenham gives his new formula for microscope object-glasses, recently read before the Royal Society. Till recently high objectives have been formed of eight lenses, a front and back triplet with a middle doublet, consequently the rays of light are subject to error arising from sixteen surfaces of glass. The author some time ago substituted a single thick plano-convex for the anterior triplet, and in so doing reduced the number of reflecting surfaces to twelve, improving the instrument so much that his system has been generally adopted. In the new object-glass the number of lenses is still further reduced to five, and the surfaces consequently to ten; in it the front plano-convex remains, the back triplet is made the centre of the system, and the over corrected rays which leave it are rendered parallel at the point of emergence by a long focus plano-convex glass. In this combination therefore the whole correction is performed by a single concave of dense flint, and therefore two single lenses of crown, whose foci bear a definite relation to each other. Dr. Urban Pritchard's excellent observations "On the structure and function of the Rods of the Cochlean in man and other animals" are given *in extenso*. Dr. E. Hofman's paper on "Hair in its microscopical and medico-legal aspects" is translated, forming a concise summary for the student of forensic medicine. Dr. Maddox makes "Some remarks on a minute plant found in an incrustation of carbonate of lime," which he considers to be of the genus *Botrydium*, and names *B. minutum*.

THE *American Naturalist* for March contains an article by Mrs. Mary Treat, on "Controlling Sex in Butterflies." The authoress, as the result of an accident, observed that the larvæ of *Papilio asterias* when underfed almost invariably developed into male butterflies, but that when freely supplied with their favourite diet, they almost as certainly developed into females. She repeated these experiments on large numbers with the same result, and has verified them on *Vanessa antiopa* and the moth *Dryocampa rubicunda*. Mr. A. S. Packard criticises these results, and shows that the earliest indications of the sexual glands appear when the larva is but little developed, and that they are often fully formed when it is adult. There are papers by Profs. Marsh and Cope on the extinct Ungulata of the Wyoming district, in which some dates of publication are fully discussed. Among the other papers are, Prof. Perkins on "The Flying Squirrel;" C. Ran, on "Indian Netsinkers and Hammerstones;" and R. Ridgway, on "The Vegetation of the Lower Wabash Valley."

Ocean Highways, New Series, No. 1.—The new form of this valuable journal is a great improvement on the original unhandy form, though we do not think the increase in bulk is very great. This number is a particularly interesting one. The first article is called forth by the Khiva expedition, and gives a summary of the commercial and political history of the Caspian, and the region to the eastward; it is illustrated by two good maps. "The Great Rivers of China" is the title of a short article by Dr. F. Porter Smith, while Mr. C. E. Austen, C.E., contributes a useful article, accompanied by an excellent map, on "Railways in Asia Minor." Mr. D. Hanbury has a short article on myrrh, the object of which is to induce travellers to collect data for its botanical elucidation. Prof. Mohn describes the origin and history of the Meteorological Institute of Christiania; a map by the same gentleman is given, illustrating the explorations by Norwegian Captains about Spitzbergen in 1872; accompanying which is a short editorial paper on Wiche's Land, defending the name given to it by Edge in 1617. One very interesting paper is by Mr. T. F. Hughes, on "Formosa and its southern Aborigines." "In this fair island of the distant eastern seas," he says, "there is still a mine of discovery and information awaiting the cunning hand of the scholar and traveller." Reviews, notes, reports, correspondence, &c., complete this interesting number.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 3.—"On the Structure of Muscular Fibre," by E. A. Shafer.

"Note on the Synthesis of Marsh Gas, and the Electric Decomposition of Carbonic Oxide," by Sir B. C. Brodie, F.R.S.

"On an Air Battery," by Dr. Gladstone, F.R.S., and A. Tribe.

Chemical Society, April 3.—Dr. Odling, F.R.S., &c., president, in the chair.—A paper on "A method of determining with great exactness the specific gravity of liquids," was read by the author, Dr. Spreagel. The instrument, consisting of a U-shaped glass tube terminating in capillary tubes bent at right angles, is very delicate when proper precautions are taken.—The second paper, entitled "Researches on the action of the copper-zinc couple on organic bodies:—No. II. on the iodides of methyl and amyl," by J. H. Gladstone, F.R.S., and A. Tribe, is a continuation of the authors' researches on this subject, an account of which they communicated to the Society some short time ago.—Dr. C. R. A. Wright then read a memoir "On Cymene from various sources," in which he gives the results of his examination of cymene prepared from eight different sources, showing them to be identical.—The last paper was by Dr. H. E. Armstrong, being No. XI. of "Communications from the Laboratory of the London Institution; action of the acid chlorides on nitrates and nitrites—Part I. Acetic chloride."

Zoological Society, April 1.—Mr. R. Hudson, F.R.S., vice-president, in the chair.—A communication was read from Dr. J. S. Bowerbank containing a description of the brain and of a portion of the nervous system of *Pediculus capitis*.—A communication was read from Dr. J. E. Gray, F.R.S., containing remarks on the genera of Turtles (*Oiacopodes*), and especially on their skeletons and skulls.—A second communication from Dr. Gray contained the description of the skull of *Sternothaerus*.—Dr. A. Günther, F.R.S., read descriptions of three new species of Flying Squirrels, proposed to be called *Pteromys tephromelas*, from Penang, *P. phæomelas*, from Borneo, and *Sciuropterus pulverulentus*, from Penang and Malacca.—Mr. O. Salvin made some remarks on the tail-feathers of the birds of the genus *Momotus*, and on the mode in which their peculiar form had originally arisen.

Geological Society, March 26.—His Grace the Duke of Argyll, K.T., F.R.S., president, in the chair. The following communications were read:—1. "Synopsis of the younger formations of New Zealand," by Capt. F. W. Hutton, F.G.S., of the Geological Survey of New Zealand. In this paper the author gave a summary of the Tertiary and later Secondary formations of New Zealand. He stated that he had been able to determine 375 species of true Mollusca, 12 of Brachiopoda, and 18 of Echinodermata from the Tertiaries; and under each of the formations which he recognises he gave the number of species of true Mollusca found in it, indicating the number of recent species, and of those belonging to other formations occurring in each. He also noticed the range and distribution of the various formations. The Tertiary groups of strata distinguished by the author are, in descending order, as follows:—I. Pleistocene, II. Pliocene: 1, the Newer Pliocene or Whanganui group: 2, the Older Pliocene or Lignite group. III. Miocene: 3, Upper or Arvatere group; 4, Lower or Kanieri group. IV. Oligocene: 5, Upper or Hawke's Bay group; 6, Lower or Waitewata group, V. Eocene: 7, Upper or Ototara group; 8, Lower or Brown Coal group. As belonging to the Mesozoic series, the author also described beds of Danian age, under the name of the Waipara formation. A species of *Belemnitella* occurs in beds belonging to the Ototara group, and also in the Waipara formation. Volcanic action commenced in the North Island during the deposition of the Waitewata group, and has since been almost continuous in the northern, western, and central parts of the island. In the South Island the volcanic formations appear to belong to the later Cretaceous, Oligocene, and Miocene periods. The volcanic rocks of the Chatham Islands belong chiefly to the Upper Oligocene.—2. "On the Tree-ferns of the Coal-measures, and their relations to other living and fossil forms," by Mr. W. Carruthers, F.R.S., F.G.S. The author pointed out that there existed in the Coal-measures two very distinct kinds of fern-stems, each represented by several species. The first group had a stem-structure like that of living tree-ferns. In them the vascular elements of the stem formed a closed cylinder round the pith; and the vascular bundles for the leaves were given off from the out-turned edges of the cylinder, where, at regular intervals, corresponding to the position of the leaves, narrow meshes occur for this purpose. In the second group the stems differed from the other group chiefly in having the ends of the vascular plates, as seen in the transverse section, turned inwards, and having the bundles of the leaves formed in a complete condition in the axis of the stem.—3. "Notes on the Geology of Kazirùn, Persia," by Mr. A. H. Schindler. In this paper, which accompanied a series of specimens presented to the Museum of the Society, the author described the section presented by the hills in the neighbourhood of Kaizirùn. The general surface was described as consisting of nearly unfossiliferous Post-tertiary deposits, immediately beneath which is an unstratified marine deposit containing a great abundance of fossils, among which are species of *Ostrea*, *Pecten*, and *Cidaris* (?). Below this deposit is a succession of strata, repeated several times in the hills, and at the bottom of the series in each case is a bed of gypsum. The spaces between the recurrent series are filled up with conglomerates. Beneath the gypseous series is a formation of compact limestone, which rises to a height of about 1500 feet both north and south of the plain of Kazirùn; its beds dip 25°, and their strike is from N.E. to S.W.

Royal Microscopical Society, April 2.—Mr. Charles Brooke, F.R.S., president, in the chair.—A paper was read by Mr. Henry Davis on a new species of *Callidina* (*C. vaga*), the distinctive characteristics of which were fully described and living specimens exhibited. Mr. Davis also detailed a series of experiments upon the dessication of rotifers, the results of which tended to prove that although they could not be revived after having been once actually dried up, it was quite possible for them to survive what was generally accepted as actual dessication, and that they would resist not only a sustained temperature of 200°, but also exposure for a long period in the exhausted receiver of an air-pump with sulphuric acid. He pointed out and proved by experiment, that during the process of drying the gelatinous matter which was secreted by these rotifers contracted around them, forming an impervious envelope and effectually preserving within it sufficient moisture to sustain life.—A communication was read from Mr. Parfitt, of Exeter, descriptive of a presumed new animal, apparently related to the annelids.—A fine preparation of malpighian capsules from the kidney, was exhibited and described by Mr. Stewart.

Anthropological Institute, April 1.—Prof. Busk, F.R.S., president, in the chair. The president read "Remarks on a Collection of Ancient Peruvian Skulls presented to the Anthropological Institute, by Mr. T. J. Hutchinson, H.B.M. consul at Callao." The skulls were collected by the Consul from the "Huacas" near Santos, to the north of Callao, which were considered by him to be those of Chinchas, or Huancas, or perhaps of Quichmas, or Aymaras, all of which tribes are now probably absorbed into the Cholas, a Mestizo race; from Ancon, from Pasamayo, about thirty miles north of Callao, and from Cerro del Oro in the Canete Valley—in all 156 specimens. After giving further detailed descriptions on the authority of Consul Hutchinson, the author passed to the consideration of the characters presented by the crania exhibited. Such of the specimens as he had been able to measure yielded the following results:—"The mean length was about 6·25 in., and the breadth 5·6 in., giving a cephalic or latitudinal index of ·905, only two falling below ·800. In that estimate were included both normally-shaped and artificially compressed skulls. The cephalic index of the supposed normally shaped, was ·873, the greatest being ·935, and the least ·812; and of the clearly artificially deformed, ·979; the greatest being 1·32, and the least ·861. Those figures showed how very much the latitudinal index was exalted by the fore and aft compression of the skull. The altitudinal index of the normal skulls was ·843, that of the compressed ·878. The mean capacity of the larger and male skulls appeared to show a result of about 80 cubic in. equivalent to brain of about 45 oz. roughly estimated, which result indicated that the crania were of small size.—The president communicated a paper by Mr. J. M. Reade, "On a human skull and fragments of bones of the Red Deer found at Birk Dale, Southport."

Meteorological Society, March 19.—Dr. Tripe, president, in the chair—The president informed the meeting that at the last meeting of Council a letter was read containing Mr. Glaisher's resignation of the Secretaryship, and that after much consideration the Council had accepted it with great regret; that they had then appointed Mr. Cator to the vacant office for the remainder of the session, and elected Mr. Glaisher to the seat on the Council thus rendered vacant, which he was glad to say Mr. Glaisher had accepted.—The first paper read was by Mr. R. H. Scott, F.R.S., "On some results of weather telegraphy," in which he laid before the Society some of the special circumstances connected with that service. He stated that the information received was insufficient, both in quantity and quality, to give a complete idea of the weather, and showed how any serious extension of the system would entail greatly increased expenditure, citing the very large cost (50,000*l.* per annum) of the American signal service, the most perfect in existance. He drew attention to the frequency of telegraphic errors, and the serious results arising therefrom. He next proceeded to discuss the probability of our deriving benefit from additional reports from the Azores, &c., and showed by actual investigation that such reports would not be of immediate use to these islands in regard of giving notice of advancing storms. The modes of conveying warnings to ships were next mentioned, and Mr. Scott stated his belief that ultimately Admiral Fitzroy's drum and cones would be adopted, though not perhaps in the significations originally attached to them.—The other paper was by Mr. W. Marriott, "On the Barometric Depression of January 24, 1872." This depression occurring in the early morning hours, very few observations had been made at the time of lowest pressure; but from those which he had received, the depression appears to have first touched the English coast near Falmouth about midnight, and to have passed along the coast to Upwey, which was reached about 3 A.M.; it then took a northerly course and passed near Birmingham at 6 A.M., after which it crossed Derbyshire, Nottinghamshire, and Lincolnshire, and passed out of the Humber between 10 and 11 A.M. He stated, however, that the evidence was insufficient to prove that this was its actual course, or whether it merely passed over England in a N.E. by N. direction at a uniform rate of about 30 miles an hour. The lowest readings of the barometer were 28·18 in. at 4.30 A.M. at Clifton, and 28·179 in. at 5.20 A.M. at Evesham. The paper concluded with a few remarks on former depressions.

Institution of Civil Engineers, March 25.—Mr. T. Hawksley, president, in the chair.—"The Mont Cenis Tunnel," by Mr. Thomas Sopwith, jun., M. Inst. C. E. This communication might be considered as supplementary to a former paper read in 1864—(Min. Proc. Inst. C. E., vol. xxiii., p. 258)—and described, (1) the Tunnel, as completed, with statistics obtained either by actual observation or from the Engineers in charge, or from official publications of the Italian Government; (2) the principal changes which had been introduced in the works and machinery underground and at the surface since the summer of 1863.

MANCHESTER

Literary and Philosophical Society, March 18.—Dr. J. P. Joule, F.R.S., president, in the chair.—"Observations on the Rate at which Stalagmite is being accumulated in the Ingleborough Cave," by W. Boyd Dawkins, F.R.S. He thinks it evident, from his researches, that the value of a layer of stalagmite, in fixing the high antiquity of deposits below it, is comparatively little. The layers, for instance, in Kent's Hole, which are generally believed to have demanded a considerable lapse of time, may possibly have been formed at the rate of a quarter of an inch per annum, and the human bones which lie buried under the stalagmite in the cave of Bruniquel are not for that reason to be taken to be of vast antiquity. It may be fairly concluded that the thickness of layers of stalagmite cannot be used as an argument in support of the remote age of the strata below. At the rate of a quarter of an inch per annum 20 feet of stalagmite might be formed in 1,000 years.—"On Methyl-alizarine," and Ethyl-alizarine," by Edward Schunck, Ph.D., F.R.S.—"On the Transition from Roman to Arabic numerals (so-called) in England," by the Rev. Brooke Herford.—"Notes on the Victoria Cave, Settle," by William Brockbank, F.G.S. For various reasons, he submitted, there is no ground for the theory of glacial action as put forth by Messrs. Boyd Dawkins and Tiddeman, but on the contrary that the filling of the Victoria Cave was the work of long ages, by the action of running water, and that there is no reason to suppose that the remains found in it are older than the glacial epoch.—The President exhibited a syphon barometer, the peculiarity of which consisted in the introduction of a small quantity of sulphuric acid over the ends of the mercurial column.—Mr. Spence, F.C.S., communicated to the Society the result of an experiment in heating a diamond, which will considerably modify the general impression as to that gem being combustible only at an extremely high heat. A friend of his had brought over a number of diamonds from the African mines. Some of these were what is called "off colour," not being purely white, and he put one of these into Mr. Spence's hands to try some experiments for displacing the colour if practicable. This diamond, the size of a small pea, was immersed in fire-clay in a small crucible, the clay being mixed with a little carbonate of soda and hydrate of lime; the crucible was then placed in a muffle, and for three days and nights exposed to a heat, which at no time was beyond a low cherry red. After cooling, the crucible was broken, and the lump of hardened fire-clay was carefully broken up to extract the diamond; after two or three fractures of the lump an impression or hole in the indurated clay was discovered just at the spot where the diamond should have been, but not a vestige of the precious stone remained.

DUBLIN

Royal Irish Academy, March 15.—The Rev. Prof. Jellett, B.D., president, in the chair. The annual report of the council was read by Dr. Ingram, secretary to council. The election of the president and members of council was proceeded with, when the Rev. J. H. Jellett, B.D., was reelected President.

Royal Geological and Zoological Societies of Ireland. A joint meeting of these societies was held on Wednesday evening, March 12. Colonel Meadows Taylor read a paper on the coal fields of Central India.—Prof. Edward Hull, F.R.S., read a paper on the Microscopical Structure of the Limerick Carboniferous Trap Rocks.—A Geological Map of New Zealand, and a fine recent specimen in spirits of *Pentacrinus Mülleri* Orst were exhibited.

PARIS

Academy of Sciences, March 31.—M. de Quatrefages, president, in the chair.—The following papers were read:—On the theory of the normal magnet, and on the means of indefinitely increasing the force of magnets, by M. J. Jamin.—On the carpellary theory of the Ranunculaceæ, by M. A. Trecul.—On the proposed apparatus for pumping out and elevating water by means of the action of waves on the shores of the Mediterranean, by M. A. de Caligny. The author has suggested a means of utilising the force of the waves for the above purposes.—New papers on the shock of earthquake in Italy, observed on the 12th of March, 1873, by M. P. de Tchihatchef.—The Academy then proceeded to elect a member in the place of the late Marshal Vaillant. After two votings, in which no candidate obtained an absolute majority, a ballot was proceeded with, when M. Cosson obtained 31 and M. de la Gournerie 30 votes. M. Cosson was then declared duly elected.—A report on two memoirs on the silicified vegetables of the Autun coal measures, by M. B. Regnault, was then read, and followed by M. Roger's fourth memoir on capillary phenomena, which dealt with the mathematical nature of the subject.—On a new method of optically determining the velocity of projectiles, by M. M. Deprez. The method consists in attaching a magnesium fuse to the projectile and observing its flight by means of two telescopes. The method is an application of that used for meteors.—The Secretary read a number of extracts from a paper on a new classification of clouds, by M. Poey.—On certain points in M. Faye's theory of the solar spots, by M. Tacchini. Father Tacchini thinks that the hydrogen carried down by cyclones, according to M. Faye's theory, would become so violently heated that it would rush back with such force as to destroy the cyclone, and also that if such a process really occurred the gas would carry up with it metallic vapours; as these are not generally visible in prominences, he thinks the explanation untenable.—On the foci (*faisceaux*) of circles, by M. Ribaucour.—On the spectrum of boric anhydride, by M. Lecocq de Boisbaudran.—On alcohol and normal acetic acid from milk considered as products of, the functions of microzymes, by M. A. Béchamp.

DIARY

THURSDAY, April 10.

Mathematical Society, at 8.—On Systems of Porismatic Equations, Algebraical and Trigonometrical; Note on Epicycloids and Hypocycloids; Locus of point of concourse of perpendicular Tangents to a Cardioid; Elliptic motion under acceleration constant in direction: Prof Wolstenholme.—On the calculation of the Value of the theoretical unit-angle to a great number of decimal places: Mr. J. W. L. Glaisher.

SATURDAY, April 12.

Royal Botanic Society, at 3.45.

TUESDAY, April 15.

Statistical Society, at 7.45.

WEDNESDAY, April 16.

Society of Arts, at 8.—On the Condensed Milk Manufacture: L. P. Merriman.

Meteorological Society, at 7.—On a proposed new form of Rain Gauge. "The Atmospileometer:" J. J. Hall.—Discussion on the Report of the Proceedings of the Meteorological Conference at Leipzig.

London Institution, at 7.—Third Musical Lecture: Prof. Ella.

THURSDAY, April 17.

Linnean Society, at 8.—Burmese *Orchideæ*, from the Rev. C. P. Parish: Prof Reichenbach.—Perigynium of *Carex*: Prof. McNab.

Chemical Society, at 8.—On Heat produced by Chemical Action: Dr. Debus, F.R.S

Numismatic Society, at 7.

Zoological Society, at 4.

BOOKS RECEIVED

English.—A Manual of Photography. 8th edit.: G. Dawson (Churchill).—Electricity and Magnetism. 2 vols: C. Maxwell (Macmillan).—Flies and Fly-fishing: Capt. St. J. Dick (R. Hardwicke).—A Catalogue of the Collection of Cambrian and Silurian Fossils in the Geological Museum of the University of Cambridge: J. W. Salter, Prof. A. Sedgwick, Prof. Morris (University Press, Cambridge).—Fever and Cholera from a new point of view: A. Smith (Calcutta).—Illustrated Guide to the Fish Amphibian, Reptilian and supposed Mammalian remains of the Northumberland Carboniferous Strata, with Atlas; T. P. Barkas (Hutchings).—A Journey through the Caucasus and the interior of Persia: A. H. Mounsey (Smith and Elder).—A Journey to the Source of the River Oxus. 2nd edit.: Capt. J. Wood (Murray.)—Turning for Amateurs.—Birds of the Humber District: J. Cordeaux (Van Voorst).—A General System of Botany, Descriptive and Analytical: Emm. de Mout and J. Decaisne. Translated by Mrs. Hooker, Edited by Dr. Hooker (Longmans).—The Principles of Animal Mechanics: The Rev. S. Haughton (Longmans).—Field and Forest Rambles: A. L. Adams (H. S. King & Co.).

PAMPHLETS RECEIVED

English.—The Agricultural Returns of Great Britain for 1872.—Quarterly Weather Report of the Meteorological Office, Pt. 2, April-June, 1872.—A Message to the British Entomologists by the Ghost of the Rector of Barham: E. W. Janson.—Journal of Mental Science, No. 49, April: H. Maudsley and Thos. Clouston, M.D. (Churchill).—The Potato Disease, its cause and its remedy: S. Smith (Smart & Allen).—General Report on the Operations of the great Trigometrical Survey of India during 1871-2: Major Montgomerie, R.E., F.R.S.

Foreign—Anales del Museo Publico de Buenos Aires, 1872-73.—Report of the Commissioners of Fisheries of the State of New York.—Recherches expérimentales sur l'influence que les changements dans la pression barometrique exercent sur les phenomenes de la vie (8th note): M. P. Bert.

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THURSDAY, APRIL 17, 1873

THE ZOOLOGICAL COLLECTIONS IN THE INDIA HOUSE

IN former days the "Hon. East India Company," in their House in Leadenhall Street, possessed a valuable Museum of Natural History. It contained specimens in all branches of science from the Company's Oriental possessions, partly contributed by public servants who had been attached as naturalists to missions and deputations sent out by the Indian Government, and partly by gentlemen of the civil and military services of the Company, as presents to the Court of Directors.

The following well-known names were amongst those who contributed to the collection:—Dr. Francis Buchanan Hamilton, Dr. Horsfield, Sir Stamford Raffles, Mr. Wallich, Mr. Reeves, Mr. McClelland, Dr. Helfer, Mr. T. T. Pearson, Dr. Falconer, Mr. Hodgson, Col. Sykes, Mr. Ezra Downes, Gen. Strachey, Col. Tytler, and Dr. Cantor. The list of contributors embraced, in fact, all those naturalists and collectors to whom science is mostly indebted for the knowledge we at present possess of the Fauna of India and the adjoining countries.

Amongst collections of special importance belonging to the East India Museum, may be noticed Dr. Horsfield's collections from Java, those made by Mr. Finlayson during Crawford's Mission to Siam, those of Col. Sykes during his survey at the Dukhun, the entomological collections made by Dr. Cantor in Chusan, and the same naturalist's collections from Singapore; the zoological collections of Sir W. Snow Harris, made during his mission to Abyssinia, and those of Commander Jones during his survey of the Euphrates and Tigris.

In 1851 the late Dr. Horsfield, who up to the time of his decease was Curator of the Museum, published a catalogue of the mammalia in the collection, which, in addition to an exact enumeration of the specimens, contains many valuable notes upon the habits, range, and other peculiarities of the species. This was followed a few years later by a catalogue of the birds of the collection, which was prepared by Mr. F. Moore, the assistant in the museum, under Dr. Horsfield's superintendence. Of the catalogue of birds two volumes were published, the first in 1854, and the second in 1858. The third, which was intended to have completed the work, has never appeared. More than a thousand species, however, are catalogued in the two first volumes, most of them represented by several specimens.

When after the Indian mutiny the absorption of the "Honourable East India Company" by Her Majesty's Government took place, the museum of the Company was moved to Fife House, Whitehall, as a temporary resting-place. The natural history collections were exhibited in this building in a very imperfect way, but it was well understood that they were only deposited here pending the construction of the new India Office, where abundance of space for their display was promised.

The time arrived when the square-towered palace in St. James's Park was finished, and the various branches of the India Office moved into it. So far, however, from there being any more space found for the natural history collections it was now discovered that there was no room for them at all. The whole of them were packed up in boxes and placed in store, and so remain to the present day, so that it is impossible to get at them for any available purpose even when the examination of a particular individual specimen is specially required.

On more than one occasion in the course of scientific work the writer has had occasion to examine some of the specimens in the collection, but has been informed that they could not be got at amongst the mass of packages. Other working naturalists have met with similar replies to their applications, and even a Russian entomologist, I have been informed, whose principal motive in coming to England was to examine some of the insects in the collection, had to return with his mission unaccomplished.

In 1871 the late Lieut.-Col. Sykes, having had his attention called to the subject by a letter addressed to the *Times*, asked the Under-Secretary of State for India in the House of Commons "when the zoological collections in the India House would be accessible to zoologists." The following is stated in the *Times* of March 15, 1871, to have been the reply given by the Under-Secretary:—

"In reply to my honourable and gallant friend, I have to say that the zoological collections belonging to the Secretary of State in Council, are, to a *certain extent*, even now available to men of science, who can readily obtain admission to examine them. They examine them however, I am sorry to say, under great difficulties, and difficulties of which I do not see the end: for even if the Secretary of State in Council were to erect on his property in Charles Street, as he has sometimes been advised to do, a building more worthy to contain the great museum and library which he possesses, than the garrets in which they are now stowed away, nearly the whole available space would be occupied by those Indian productions which it is important to bring under the notice of the commercial classes of this country, and pure science would, I fear, come off very badly."

The "*certain extent*" to which, according to this reply, the collections are "*even* now available to men of science," may be judged of from what has been already stated. But in fact, it was ultimately admitted by the Under-Secretary, after a little pressure on the part of the questioner, that the collections were "boxed up;" nor has any change been made in their condition since that period.

It must, I think, be obvious to all those who have read the statement above given that a gross wrong has been perpetrated in the present case. When the Imperial Government took possession of the late East India Company's establishment, they were manifestly bound to perform the duties attached to it. To nail up the whole of the natural history collections in closed cases, and deposit them in a cellar is a strange way of accepting the *officium cum onere*. It is a wrong, not only to the labourers in science who have occasion to consult the collections, but also to the many distinguished officers of the late Company's service, who contributed to form them. The longer the present state of things continues, the greater will the wrong become, as it is almost impossible to prevent the ravages of insects in the case of specimens of natural history of any sort that are stowed away without periodical examination.

It being, however, hopeless to expect that the India

Office, in its present economical fit, will spend the money necessary to build a Museum for the proper exhibition of its collections of manufactures and natural history, the following two solutions of the difficulty may be suggested.

(1) That an arrangement be made with the Commissioners of the Exhibition of 1851 to exhibit the collections at South Kensington, either in one of the existing buildings, or in one to be constructed for that purpose. The French have an "Exposition des Produits des Colonies" in part of the former Palais de l'Industrie in the Champs Elysées, and there is no reason why we should not follow so desirable a precedent.

(2) If this cannot be effected, the whole of the collections should be transferred to the trustees of the British Museum. It is, of course, quite certain that the trustees could not exhibit them, looking to the crowded state of their galleries in Great Russell Street. But at all events they would be thus saved from risk of further deterioration, and might be rendered accessible to working naturalists who have occasion to consult them. P. L. S.

UNIVERSITY OARS[*]

III.

We have stated that in our opinion the evils of boat-racing as now practised are traceable to two causes, 1st to a misconception of the nature of the demands which it makes on the several energies of the body; and 2nd, to the system of preparation, or, as it is technically called, *training*, which is undertaken to enable the body to meet these special demands upon its energies.

In our remarks last week we stated at some length wherein lay the first of these misconceptions, namely, in the nature and extent of the effort made by the muscular system and the respiratory and circulatory system, respectively, showing that while the exertion was slight, if not actually inadequate to the requirements of the former, it was both in amount and character severe, if not absolutely dangerous, in the latter.

The origin of the first misconception, and the reason why it should have lived so long, and should still live, we think may be thus explained. When rowing was first adopted by lads at schools and young men at universities as a regular mode of exercise, and friendly matches of speed and dexterity were organised, the boats used, probably, were not greatly different in size, in shape, or in other points of construction, if in any, from those at the time in use by professional watermen; and the manner of rowing was also, very probably, after the waterman's type. If this were the case then rowing furnished abundant exercise, not only to those portions of the rower's frame which still receive a fair share of employment, but to those also which are at present virtually excluded from the task, or have a very inferior part to play in it; for the heavy, bulky, broad and deep boats, clumsy, unwieldy, and unskilfully arranged oars and rowlocks, would necessitate a slow and protracted stroke, and both upper and lower limbs would have their part to play and their work to do in dragging the oar through the water. Gradually, changes and improvements would be introduced, lessening the labour, heightening the art, until art and labour in boat propulsion attained their present positions and proportions, the former reduced to a minimum, the latter standing eminently high: but just in proportion to the prominence of these conditions are its merits as an exercise in an inverse ratio to be estimated. There was plenty of muscular exertion for the whole frame in lugging along the old-fashioned boats. There was little or no distress to heart or lungs in its protracted stroke and deliberate pace. We frankly confess that there would be little in the old style of boat-racing to create and sustain the enthusiasm at present displayed in these contests; and we are expressing no regret at the changes that have taken place, and no wish to return to their primitive, albeit safe conditions: what we do wish is to let rowing remain as it is, nay, to let it pursue its onward course of change and improvement like all other things, but to see if the old order of safety cannot be retained with these advancements, by obtaining from other sources those properties which recent changes have altogether eliminated or reduced to inefficient proportions.

To glance at the reason why the misconception regarding the actual nature of a boat-race as now rowed, should have so long existed, and should still exist, we think it needs only to be pointed out that only quite recently has any really critical inquiry been instituted on the subject, and when the results of this inquiry were made known, they savoured to the oarsman like the prescribed "nasty medicines" to the child; *i.e.* whatever good they may have been calculated to effect, they were nevertheless unpalatable, and if not actually rejected were at any rate swallowed with dislike. But rowing men are not singular in this respect, in claiming for their favourite exercise, through all its changes, in all its attributes, *perfection*; they are claiming no more than all enthusiastic votaries of a special exercise claim, and many with less excuse and less right to an indulgent hearing than the oarsman. "It gives exercise to every muscle of the body," say they, "No exercise whatever," we reply, "does this." No single exercise gives more than employment to a portion of the body, and to that portion sometimes a very inadequate share.

The errors involved in the second misconception in a great measure originate in the first, and their nature is revealed, and the manner of their connection explained as we proceed in making ourselves acquainted with it. Thus an oarsman at a given time will be called upon to row a race which will tax his bodily energies *such as he knows them, or believes them, to be*, to the uttermost; the effort will be quite exceptional in its severity and he therefore desires to prepare for it, to fortify himself for it, by every means in his power. Now it need hardly be said that if he is ignorant of the nature of the demands which the effort will make upon him, he cannot rightly prepare himself for that effort; nay, he may, and probably will, go wrong, for advice will be pressed upon him at all hands, and here at any rate, "In the multiplicity of counsel there is *not* wisdom." When it is remembered that this preparation or training embraces the administration, or use, of all the material agents which sustain life and give health and strength, it will not be wondered at that mistakes have been made in this direction, and that man should have come to speak of the *ordeal*(!) of training as of a trial as great if not greater than the effort itself for which the training was instituted. Thus one of Dr. Morgan's correspondents who rowed bow at Putney in 1849, Rev. D. Wauchop, Wadham College, Oxford, and a friend of our own of long standing, writes: "A curious circumstance with regard to training I would mention, and that is that one of the most sinewy and lasting men of my friends, who had been accustomed to rowing since he was little more than a child, and who was a particularly steady and temperate man, and so good an oar as to be chosen stroke for a time, never could stand training. After a few days of it he invariably broke down, and therefore never rowed in a race."

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[*] Continued from p. 418.

It will therefore be easily seen how great must be the advantages to rowing of clearing up what we have called the *first misconception*, in the light of its effects upon the health of the men engaged in it—the only light which would justify our having entered upon the subject at such length in the columns of a purely scientific journal. Thus while it was imagined that rowing entailed tremendous muscular exertions upon the oarsman, rules as to *diet*, *sleep*, and *exercise* were laid down to meet such exertions, one authority recommending men to be in bed ten or eleven hours; for diet underdone meat in vast quantities, and without vegetables—"not even a potato"—was prescribed, while exercise of any or all kinds put together was cut down to less than one hour in the twenty-four. Thus did the first misconception sustain and prolong the existence of, if it did not give origin to, the second.

The errors in *sleep* and in *diet* are being rapidly cleared away. They are destined soon to be numbered among the vagaries of the past, and in this place we may already pronounce them undeserving of serious exposure or condemnation. With the other agent of health named above, however, as affected by a want of true knowledge of the exertion undergone in rowing, namely, exercise, the case is different. The errors on this head are still many and grave, and to the correction of them we must look before we can expect to see any material improvement in the hygienic value of rowing; it is to exercise we must look to restore the lost equilibrium of rowing on the several systems of the body; to exercise we must look to equalise the partial developments of the frame now caused by rowing as exclusive of muscular exertion; to exercise we must look for that increase in vigour and power and functional capacity generally, now wanted to enable the organs of circulation and evaporation to sustain the extreme effort which they are called upon to fill during a boat-race.

We will assume that we have established that in rowing the chest and upper limbs receive an inadequate share of the exercise, and therefore in accordance with the organic law regulating material development and functional capacity,—that "*these will be in relation to employment*," —an advancement in these respects will be shown in those regions, inferior to what is observable in other parts of the body when the employment is greater. This assumption being admitted, it will also be admitted that any want of development or capacity experienced in these regions—whether in the power of the muscles aiding respiration, in the size or conformation of the thoracic cavity, or in the size, conformation or capacity of the organs which they contain,—would affect, and affect in an increasing ratio with its extent, the respiratory effort during a boat-race.

We admit that we are somewhat at issue with Dr. Morgan, inasmuch as he does not go with us so far as to acknowledge this partial division of the labour, and consequently of the reward to the parts engaged, in the act of rowing; but he *does* acknowledge that if it *did* exist, the right way to its rectification would be to supply to the parts found wanting, employment elsewhere and in other form. This is nearly all that we can desire—perhaps more than at this date we have yet a right to expect from a devoted oarsman, jealous of his craft. His language is emphatic and significant:—

"In examining patients for insurance companies, I have frequently refused the lives of young persons on the ground that their chests were narrow and shallow. In several instances, however, these thoracic defects have been corrected by a systematic course of gymnastic exercises, justifying me at a later period in recommending their acceptance. At no time and in no place could every useful variety of exercise be more advantageously carried out than at Oxford and Cambridge; they might, for the class by which they are frequented, serve as valuable national gymnasia."

Dr. Morgan might have taken a wider base for his congratulations on the establishment of gymnasia than Oxford and Cambridge; the greater number now of our public schools are also so provided, namely, Uppingham, Radley, Cheltenham, Clifton, Marlborough, and Rugby. We place them here in the order in which they have been carried out, Rugby being our last organisation. From all these schools men are coming up to the Universities, after having continuously, during the most important period of their growing time, received a course of carefully systematised bodily training, carried out in buildings specially designed for this purpose, and conducted by teachers duly prepared, and bearing certificates of qualification. All the youths will bring with them not only chests "larger and deeper," with hearts and lungs stronger, ampler, and more vigorous, but the knowledge of what a good strong, or well-formed chest is, how it is got, and how it may be lost; and this with the similar advantages of the Universities, and shared in by University men, will surely in time enable us to overcome the evil of rowing, the danger to rowing men: for the whole question is now narrowed to one point. Give to men who now take rowing as exclusive exercise such other exercise as will develope the parts of the body which rowing but imperfectly employs, namely the chest, and you at once endow with vigour and strength the parts that are dangerously taxed in the boat-race. We have known men standing 5 ft. 9 in., with chests measuring 32 in. only, rowing in their college eights! And men standing over 6 ft. in their stockings, with chests measuring 35 in., rowing in the inter-University race at Putney! To what end can these lead? to what but danger to the men, alarm to their friends, and injury to the name and to the interests of the art to which they affect to be devoted. We repeat here what we uttered years ago—"No man of ordinary stature and fair growth should be allowed to put hand upon an oar in a racing boat until his chest has the minimum girth of 36 in.; less will not give him space adequate to the full and fair action of the vital organs within, in the work upon which he would engage; less no man of ordinary stature and fair growth need pass his eighteenth year without possessing."

In bringing these remarks to a close, we desire heartily to congratulate Dr. Morgan on his book, both in conception and execution, and also to congratulate University oarsmen in having a work of this character dedicated to investigations of the doubtful and disputed points of their favourite exercise. If he has not succeeded in showing that the Putney course is quite free from danger, he has shown that it is not so perilous as it was pronounced to be,—*i.e.* not the *via mala* which it had been named. To the disputants on both sides we would say with the peace-loving innkeeper in Silas Marner, "Ye are both right and both wrong; shake hands and be friends."

ARCHIBALD MACLAREN

THE MAMMALIAN SKULL

Zur Morphologie des Säugethier-Schädels, von Joh. Chr. Gustav Lucae. With three lithographic plates and eight woodcuts. (Frankfort, 1872.)

THIS contribution to the anatomy of the Mammalian skull treats chiefly of the comparative proportions of those of Carnivora and Ruminants. After quoting Prof. Huxley's dictum on the importance of making longitudinal sections of every skull in an ethnological museum, the author justly insists upon its applicability to comparative osteology; and begins by a discussion on the true cranio-facial axis. He reviews the definitions adopted by other writers, and describes it as extending from the anterior margin of the *F. magnum* to the *F. cæcum*, thus including the basi-occipital, basi-sphenoid, pre-sphenoid, and cribriform plate of the ethmoid bone. He regards it not as a mere imaginary line drawn through the centres of these links in the chain, but as the actual solid elongated mass which they form when the surrounding parts are removed. Hence he speaks of the upper surface of the cranio facial axis, or, as he prefers to call it, the base of the skull, turned towards the brain, and its lower surface turned towards the pharynx and face.

The discrepancies between the different anatomists who have written on this subject have been chiefly due to the different objects for which the structure of the skull has been studied. To the morphologist, guided by a knowledge of embryology and comparative anatomy, it appears monstrous to include the diameter of a foramen as part of the base of the skull, formed of a series of bones which agree in their relations and partly in their development with the centra of the vertebræ. On the other hand the descriptive zoologist, and especially the ethnologist, to whom "transcendental anatomy" is apt to appear harsh and crabbed, asks fairly enough that he may be allowed to fix upon such a base-line as shall give him the most useful and convenient method of comparing the shape of different skulls. And if the practical physician tries as well as he can to ascertain the dimensions of the cranium during life, he is obliged to content himself with the best base-line he can get, which is probably that from the root of the nose to the most hollow part below the occipital protuberance.*

Prof. Lucae's object is a morphological comparison between the skulls of man and certain other mammals, and for this purpose we think his cranial basis is well chosen. It agrees with the "cranio-facial axis" adopted by Prof. Flower in his "Osteology of the Mammalia" (pp. 104, 105), in the chief point in which it differs from Huxley's "basi-cranial axis" (Journal of Anat. and Phys., Nov. 1866, p. 67, and "Anatomy of Vertebrated Animals," p. 23), namely, by the inclusion of the mesethmoid bone. And it differs from Prof. Cleland's "base-line" (Phil. Trans., 1869, p. 122), by the exclusion of the foramen magnum, as well as in being an actual mass of bones instead of a line drawn for purposes of measurement.

The most important question is, whether the line of bones which continues the centre of the vertebræ forward should be considered to stop with the pre-sphenoid or no. Having passed the basi-sphenoid, with which the notochord ends, and admitted the pre-sphenoid into the cranial axis, there seems no good reason from the development, the structure, or the relations of the bones, for not including in the series the next in order. And this must be the mesethmoid: for the claims of the vomer to be considered the centrum of a nasal vertebra may be put aside, because unlike the rest of the axis it is developed from membrane, because it takes no part in supporting the cerebrospinal axis, and because it is not articulated with the frontals or even with the anterior end of the pre-sphenoid.

Having defined the cranial basis, Prof. Lucae proceeds to compare the inclination of its four segments to each other and to a right line joining its two ends. This line, which in man of course will fall *below* the base of the skull, falls *above* it in Carnivora, and more or less completely *in* it in Ungulata. The differences chiefly depend on the greater or less inclination of the brain to the medulla oblongata, and the more or less horizontal position of the face and hence of the olfactory nerves. Careful measurements are given of the dimensions of the segments of the cranial axis and of the angles they make with each other in six Carnivora and eight Ungulata.

Next follows a comparison between the vault of the cranium and the facial bones in the wolf and antelope (*Redunca ellipsiprymna*). The compact osseous structure of the former is contrasted with the more spongy character of the latter; and it is shown how the position of the centre of gravity is altered by the great canine teeth of the carnivora and the horns of ruminants. A short section follows on the changes brought by age; and then come measurements of the cranial angles in various marine Carnivora, in Rodents, in the pig, barbirussa, and *Hyrax*. The last section treats of the skulls of monkeys and of man. Here the cranial axis, which in the seals is somewhat concave above, in otters almost flat, and gradually more bent in Carnivora and in Ruminants, has become strongly convex above, so as to make the cribriform plate and the foramen magnum horizontal instead of vertical, while the length of the vault of the skull in comparison with its base (as above defined) has enormously increased. The remarkable twisting down of the face under the cranium in some Ruminants (for it is little marked in the deer tribe), which is here noticed, has been already well described by Prof. Flower in the work above quoted. It is a remarkable character, but certainly not enough to warrant us in pushing the Ruminants between the Carnivora and the lower apes.

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* See an interesting paper by Dr. Gee in the St. Bartholomew Hospital Reports for last year.

The woodcuts and lithographic figures of this paper are not very clear, even with the aid of red ink to distinguish the outline of the section of a skull from its profile, when printed together; and there are several printers' errors, e.g., *Hydracherus* for *Hydrochoerus*, and what is more important, *hintre* is put for *mittlere* (p. 27).

Prof. Lucae modestly compares his work to that of a hodman, who has plenty to do when kings build their palaces. These royal castle-builders are of course the more or less adventurous theorists who construct their *Stammbäume* by help of such anatomical details as are here collected. All zoologists, whether, like Lamb's nurse, "wise and wondrous skilled in genealogies," or contented to work out the raw material which is always necessary, will welcome such contributions to osteology as the present, which forms so excellent a continuation of the author's previous labours on *Raçenschädel*, and will hope that they may be still further extended in the same direction. P. H. PYE-SMITH

SYMONDS' RECORDS OF THE ROCKS

Records of the Rocks. Notes on the Geology, Natural History, and Antiquities of North and South Wales, Devon, and Cornwall. By Rev. W. S. Symonds, F.G.S. (London: John Murray.)

MR. SYMONDS is an enthusiast, and one of the best type. In the intervals of his clerical work he is pretty sure to be found either with his hammer among quarries, ravines, and railway cuttings, or exploring some crumbled ruin or mouldered encampment, or lecturing volubly to a hill-side auditory on the rocks beneath their feet, or showing his well-known features at the sectional meetings of the British Association. Such have been his favourite pursuits for some thirty years. In the present volume he gives us jottings from the note-books which record his doings during that long period. The book is not a formal scientific treatise, nor does it follow any definite geographical sub-division in the districts described. An introductory chapter of a somewhat miscellaneous kind is followed by ten others devoted to the various palæozoic formations of Wales and the South-west of England. But the writer does not confine himself to the geology of the various districts, he has much to say about antiquities and natural history, and says it pleasantly enough. Nor does he restrict his remarks to those parts of the country mentioned in the title-page, for he has been away up even into the wilds of Sutherlandshire, and tells about the rocks there and the alpine plants, and the minerals, and the old glaciers, and how he broke a trusty rod in fishing for salmon there. He makes his way cheerily wherever he goes, and duly chronicles the kindness shown to him. The perfect honesty and candour of the writer are conspicuous throughout. Now and then, however, the delight with which he has seen a fact for himself leads him to write as if nobody had seen it before him. For instance, on p. 91, he tells that "on an expedition two years ago in company with Captain Price, I ascertained that the quartz-rock of Queenaig with its tubes rests unconformably on Cambrian sandstone." A very good observation, Mr. Symonds, but not unknown before you and the Captain were up there.

The illustrations, which are numerous, have been largely taken from Murchison's "Siluria;" but we can specially commend some new engravings from drawings by Sir William Guise—admirable both for their artistic conception and geological truth.

OUR BOOK SHELF

Yarrell's History of British Birds. Revised by Alfred Newton, F.R.S., Professor of Zoology in the University of Cambridge. Part V.

THE improvement which Prof. Newton's excellent edition of Mr. Yarrell's work is undergoing by passing through the hands of its accomplished and assiduous editor, is evident on every page, and the care with which the large mass of literature on the subject of most of the species has been studied, must be evident to all readers. The chief features of this part are the following. The author has entered with considerable detail into the puzzling question of those forms or species of blue-throat, *Ruticilla suecica*, *R. leucocyana* and *R. wolfi*—of which the first only can be said with certainty to have occurred in this country. The so-called "Melodious Willow Wren," of which two examples have been met with in the British Isles, is shown on Mr. Dresser's authority to be the Icterine Warbler (*Hypolais icterina*), and its distinction from the nearly allied Polyglot Warbler (*H. polyglotta*) is carefully pointed out, and it may be mentioned that these two birds have only a superficial resemblance to the true Willow-wrens, among which they have been erroneously placed by most British authors. The evidence as to the occurrence of the Marsh Warbler (*Acrocephalus palustris*) in England is shown to be very defective, and the editor declines admitting it at present to our fauna. The Aquatic Warbler (*A. aquaticus*) on the other hand, seems to have been obtained some three if not four times. The history of that very interesting species Saddler's Warbler (*A. luscinioides*) is fully given, more so than is done in any other work with which we are acquainted. It was doubtless in former days a regular, though never a very abundant summer visitant to the eastern counties of England, until the drainage of the meres and fens unfitted wide districts for its habitation. The first example of the species ever brought to the notice of naturalists was obtained early in the present century by a party of Norfolk observers, including the late Sir William Hooker. This specimen was in 1816 shown to Temminck, then on a visit to London, and by him said to be a variety of the Reed Wren, a bird from which it may be fairly separated generically. Some years after, Sair described it from Italian examples, and it has always had the reputation of being a southern species. But it is to Englishmen that we owe nearly all the information we possess concerning it. Its nest and eggs were discovered near Cambridge in 1845, three years before anything was published about them on the Continent, and its peculiar habits have been chiefly described by Englishmen, from their own observation, whether in this country or abroad. The account of this species has been written *de novo*, and great pains has indeed been taken to bring the history of all the other birds treated in this part (fourteen in number) up to our present state of knowledge of them.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Cave-deposits of Borneo

THE following letter from Mr. Everett to myself was accompanied by a plan and section of one of the caves visited by him and partially excavated. The deposits were as follows:

		ft.	in.		ft.	in.
1.	A thin layer of stalagmite.					
2.	Black impure guano	0	3	to	1	0
3.	White clay with *Potamides decollatus*	1	0	,,	2	6
4.	Guano		variable			
5.	Débris of clay and guano, with fragments of limestone and stalagmite in abundance...	?2	0	to	3	0
6.	Pure yellow felspathic clay	4	0	,,	5	0
7.	Limestone floor.					

This particular cave could not be readily worked owing to the influx of water, but other caves exist at higher levels which would be more promising. The expense for six months' work, according to Mr. Everett's estimate, would not be more than the mere passage-money of anyone going out from England. I may add that Mr. Everett quite understands the proper mode of working, having had personal communication with Mr. Pengelly on the subject at Kent's Cavern. He is now thoroughly familiar with the country and the workmen to be employed, and it seems a great pity that advantage should not be taken of his residence in so interesting a locality, the proper exploration of which may throw light on a variety of biological problems.

ALFRED R. WALLACE

"You will recollect that some three years ago I came to Sarawak with the object of making general collections of natural history and, more particularly, of investigating the cave-deposits of Borneo.

"From time to time I made excavations in various caves situated in Upper Sarawak, being assisted pecuniarily by the Rajah to a certain extent. These excavations varied in depth from 4 ft. to 14 ft., and were made in different situations in the caves. No remains of interest, however, were discovered beyond some teeth of a Hystrix, and bones of man, bats, geckoes, &c., in the most superficial deposits, and the only result worth recording was the find of a stone axe-head in a bed of river-gravel. This celt was forwarded to Sir C. Lyell, and such remains as were obtained from the caves were sent to Messrs. Busk and Pengelly at intervals; but the latter, together with a recent tooth of Rhinoceros and two collections of miscellaneous specimens, appear to have been wrongly transhipped in Singapore, and I have never been able to trace their whereabouts.

"After considerable observation and experience I now wish to state with all frankness my belief that my work was not carried on as it should have been, and that the non-existence of ossiferous deposits in the Bornean caverns is very far from being a proven fact. The inquiry as conducted by myself was not *thorough*, and it was unsatisfactory partly because I was in serious pecuniary difficulties myself, and partly because what I saw of the poverty of the Government and the remarks I heard dropped about the folly of expending money on such objects made me very shy of taxing the Rajah's liberality. I was, and am still, persuaded that the expense of cave-working in a country like this would have proved very much heavier than the Rajah had any idea of, and hence I worked with inadequate support.

"In the event of those who are interested in the exploration being desirous of having it continued, I venture to suggest that the person chosen for the work must either possess considerable private means or he must be employed at a regular salary; and further, that the work should be carried on with sufficient funds to render it independent of any assistance the Government here might afford. Money is so scarce here, and public wants so many and pressing, that assistance for purely scientific objects is not to be expected. Coolies are not procurable now under a wage of 2*l.* a month, and, owing to the rivers being the only roads, travelling expenses are heavy. For tools, lights, gunpowder for blasting, and such preliminary expenses, a sum of 15*l.* would be sufficient; and the monthly working expenses would vary from 10*l.* to perhaps as much as 15*l.*, according to the accessibility of the cave to be explored; so that for working a cave for three months a sum of 65*l.* would probably be required.

"As I am now employed in the Government service, I do not think I could undertake the work unless a formal application was made to the Rajah for the necessary leave of absence. Even were leave obtained, I do not suppose that I should continue on Government pay, and I could not afford to undertake the work under a salary of 25*l.* per month. The cheapest way of conducting the exploration would be to send out a gentleman of independent means who would do the work for its own sake, and then only the actual working expenses need be subscribed for. Supposing remains were ultimately found, the item of freight would have to be added to the working expenses.

"I am induced to write you this letter from reading a note in NATURE for June 13, 1872, with regard to the Victoria caves, in which two years of constant but seemingly fruitless work has in the end proved successful. Trusting that another exploration may be attempted in this far more important field, and with like success, I remain, &c., "A. EVERETT

"To A. R. Wallace,
"Sarawak, February 1, 1873"

A Fact for Mr. Darwin

THE interesting fact contained in the following passage appears to me to deserve disinterment from the pages of a very large book, a work too, which, so far as I know, has never been translated. It occurs in the "Erpétologie Générale" (Par Duméril et Bibron, tome vi. p. 467), and I met with it while employed in working out a collection of reptiles, which I was engaged in classifying. The passage is as follows:—"Dans les villes d'Égypte, on rencontre souvent des charlatans exposant à la curiosité publique des Eryx javelots vivants auxquels, afin de les faire passer pour des Cérastes, ils ont en le soin d'implanter, en manière de corne, audessus de chaque œil, un ongle d'oiseau ou de petit mammifère, par le même procédé que celui qu'on emploie dans nos fermes pour fixer deux ergots sur la crête de certains coqs quand on les chaponne.

"C'est d'après des individus ayant la tête ainsi armée de deux fausses cornes, qu'Hasselquist a fait son Anguis cerastes. Nous avons dans les collections du muséum des individus dont la tête porte ainsi des ongles recourbés d'oiseau, avec leur cheville osseuse, dont l'adhérence à la peau est parfaite."

Here is a fact, not only well authenticated, but capable of verification, demonstrating such close affinity of intimate structure and function between animals of *different classes*, that the skin appendage of one has been actually engrafted upon the skin of the other; the claw of a bird has formed perfect union with the skin of a snake. A good illustration of the affinity between birds and reptiles pointed out by Prof. Huxley.

I do not notice that statement about the claw of a small mammal being used for this purpose, because specimens illustrating it are not referred to.

The snakes alluded to in the passage are the *Eryx Jaculus* (one of the Erycidæ or sand-snakes of Dr. Günther), which is perfectly harmless: and the *Cerastes Hasselquistii*, a small but fierce and venomous viper; both inhabiting Egypt, and the latter supposed to have been the "asp" of Cleopatra. The Cerastes obtains its name from the so-called "horns," peculiar to the males, which are developed from modified scales over the centre of each orbit, attaining the length of about half an inch. The Eryx is about the same size as the Cerastes, for which it is passed off by the Egyptian snake-charmers, when manufactured as above described. H. D. MASSY

Grenada Villas, Netley, near Southampton

The Phœnician Vademecum

IT is gratifying to see (vol. vii. p. 351) that you express a doubt whether the Cowrie shells in the Pomeranian barrows must necessarily, as Wagner supposes, have been brought by the Phœnicians. Because the earliest Greek historians introduced the Phœnicians to us they have been employed as a universal machinery for carrying out all kinds of operations. This theory is in fact incompatible with our present knowledge of the duration of the human race, and, we may say, with the relative antiquity of the Phœnician epoch, which can date but little beyond the historic period. Thus we are led to neglect the evidences of skulls, weapons, tools, monuments, and languages, which show that there must have been communications between distant regions long before the rise of the Phœnicians. There are many prehistoric races which had a sufficiently wide distribution to provide for the dissemination of such a small object as the Cowrie. Among these may be named the dwarf or short races, of which the Mincopies of the Andamans are a type; the race now represented by the Agavs of the Nile, Avkhass of Caucasus (Achivi), and Omagua and Guarani of Brazil; and the Dravidian race. Populations which could distribute men over the continents and islands of Europe, Africa, Australia, and the Americas must have been capable of distributing cowries and beads without Phœnician intervention. At present the Phœnicians are blocking the road to prehistoric research, as the Hebrews formerly did. HYDE CLARKE

32, St. George's Square, S.W.

Earthquake Waves

THE observations at p. 385, on the operation of self-resisting tide-gauges of the U. S. Coast Survey, in illustrating the phenomena of earthquake waves, suggest the expediency of the same means being adopted in the basin of the Mediterranean. This could possibly, by a little correspondence and agitation, be effected at Naples, Athens, Constantinople, and Alexandria. The Turkish and Egyptian Governments are very likely to listen to any representations on behalf of the cause of science. Although the Mediterranean is considered tideless, there is a daily fluctuation of two feet in parts of the Levant, but what is material is that earthquake waves are known to have been manifested at Smyrna.

If our Government could be induced to encourage observations at Gibraltar and Malta, we should obtain a combination of points of contact for two allied regions.

HYDE CLARKE

Spectrum of Aurora

I WISH to make a correction with reference to my observations on the spectrum of the aurora, as given by J. R. Capron on p. 182; for he has credited them with greater accuracy than they profess to have: I have no doubt that my line No. 5, seen at wave-length 500 or 510, is the same as Lord Lindsay's and Elger's No. 4, and probably as Procter's. This is the more likely, seeing that the two former placed the principal line much nearer the red end than I did; for I assumed Angström's position (5567) to be correct. This leaves but one observer of No. 5 (Barker), and possibly his line also is the same; in that case his No. 4 will be the same as Lord Lindsay's No. 3.

I have seen published the following determinations of the positions of the auroral lines, in addition to those J. R. C. has given:—

		Wave-length.
No. 1.	R. J. Ellery	635
No. 2.	O. Struve	5545
	Angström	5567
	German North Polar expedition	5569
	Peirce (as reported by Winlock)	557
	Respighi	5573
	R. J. Ellery	560

No. 3. Peirce has two lines near here—5315 and 5205; the latter is probably Lord Lindsay's "line near E," and possibly A. Clark, Jun.'s line also.

		Wave-length.
No. 6.	Peirce	464
No. 7.	Peirce	431

Peirce also gives lines at 545 and 486.

My latest determinations from my own observations are as follows:—

	Wave-length.
No. 1.	606
" 2.	566
" 3.	5165
" 4.	5015
" 6.	4625
" 7.	4305

I have never seen a line at 532 again.

As to the continuous spectrum, it reaches from No. 2 to No. 7, being brightest from a little beyond No. 2 to No. 6. This part of the spectrum does not give me so much the idea of a true "continuous spectrum broken up by dark bands," as of a series of bright bands too close to be distinguished.

Sunderland T. W. BACKHOUSE

Spectrum of Nitrogen

IN a paper communicated to the Royal Society by Mr. Arthur Schuster, it is stated that the line spectrum of nitrogen may be obtained under all pressures and temperatures if every trace of oxygen be removed by heating sodium in the vacuum tube.

I should be glad to learn whether any of your readers have successfully treated Mr. Schuster's experiments. My friend, Mr. Lee, and myself have, on several occasions, attempted to do so, but always without success.

On heating the sodium we invariably find that an increase of pressure takes place from the liberation of hydrogen which, although very greatly lessened, is not entirely removed by drying the gas with sulphuric acid. On again exhausting we obtain, with the simple current, a spectrum of lines, not of nitrogen, but, in every instance, those of the second so-called hydrogen spectrum first described by Plucker, and afterwards noticed by Wullner and Angström.

This spectrum disappears as soon as the Leyden jar is used, and only the ordinary hydrogen spectrum is then visible.

The only effect which the sodium appears to produce is the liberation of hydrogen; for the same line spectrum can be obtained by exhausting a tube filled with hydrogen, or even with unpurified atmospheric air.

I was struck by the fact that only a few of the lines given by Mr. Schuster in his table of wave-lengths coincide with those of the known spectrum of nitrogen, while many of its most brilliant lines, including that which is its chief characteristic, the double green line (wave-length 5005·5002, Thalen) are not represented in his spectrum.

That the line spectrum of nitrogen can be obtained at all pressures, has been shown in a paper by Mr. Lee and myself, which has been sent elsewhere for publication; but that it can be obtained at all temperatures, by which, I presume, Mr. Schuster means either with or without the Leyden jar, is certainly contrary to our experience.

Liverpool C. H. STEARN

Instinct

The Heredity of Instincts

THE following may perhaps serve as a contribution to the question so much discussed of late concerning the transmission or acquirement of likes and dislikes amongst the lower animals. It is an extract from a letter of a brother of mine, an officer in India:—

"I have at present a little tiger-cub, about the size of a spaniel, a most interesting pet, though it will soon be a dangerous one. He made friends at once with my fox-hound puppies, and romps with them incessantly. When he sees a cow or a goat his real nature betrays itself. He has no fear whatever of any dog; *but, strange to say, is thrown into a paroxysm of terror at the sight of a kitten or a tiger-skin.*"

This hardly seems to bear out the assumption so commonly made, that manifestations of this kind must have a history in the experiences if not of the animal itself, at least of its ancestors. We can hardly suppose the parents of this cub to have adopted a frame of mind respecting the race of tigers equivalent to misanthropy amongst ourselves, and the experience of cats or kittens must be small indeed in the jungles of the Decan.

St. Asaph, N. Wales J. G.

Sense of Direction

IN Mr. Darwin's article in NATURE for last week there is a passage about "the sense of direction being sometimes suddenly disarranged," that brought to my mind assertions I had frequently heard made when travelling some years back in the wild parts of the State of Western Virginia. It is said that even the most experienced hunters of the forest-covered mountains in that unsettled region are liable to a kind of seizure; that they may "lose their head" all at once, and become convinced that they are going in quite the contrary direction to what they had intended, and that no reasoning nor pointing out of landmarks by their companions, nor observations of the position of the sun, can overcome this feeling; it is accompanied by great nervousness and a general sense of dismay and "upset;" the nervousness comes after the seizure, and is not the cause of it. I was present in a company of hunters when a tale of this "getting turned round" was told as a good joke against one of the party —a Nimrod of renown—the leading features of which he was reluctantly obliged to confess to the truth of, while denying some minor points that had been added to embellish it, as making him more ridiculous than he was: it would take up too much of your space to tell the particulars of the story. The feeling is described as sometimes ceasing suddenly, and sometimes wearing away gradually. Would it not be strange if it should appear that there is a "sense of direction" other than an acquired sense of direction the result of unconscious observation, and that some animals possessed the first in a pre-eminent degree? The wonderful faculty hunters possess of finding their way through immense mountainous tracts so thickly wooded that one cannot see farther than a few yards at a time, may perhaps be accounted for by this power of unconscious observation alone; but is it so easy to account for a sudden derangement of the sense of direction, and the peculiar distress it occasions, even when there is no ground for alarm on the score of safety? This appears a kind of converse of the instance Mr. Darwin gives of the case of old persons losing their way. HENRY FORDE

The Walk, Lyme Regis, April 6

Destruction of Rare Birds: White Tom Cats

MANY of our birds are now protected by law, at certain seasons of the year. But unhappily rare visitants are mercilessly killed. Last year a pair of Hoopoes frequented my grounds both in the spring and autumn. It was a great pleasure to see this bird (of which Horapollo wrote that it was worthy to be "the sceptre of the gods on account of its gratitude"), on the lawn, busily searching for insects, or alighting on the surrounding trees. Every lover of nature will sympathise with my household and myself, in our distress that they have been shot; not even for the miserable satisfaction of the mere collector, but far worse, that their plumage might be stuck on a lady's head-gear. To shoot storks, spoonbills, bee-eaters, hoopoes, &c., which might be regular visitants and nest here, is a very different thing from securing chance arrivals from remote regions, which could never be naturalised in England.

One of your correspondents wrote recently of the deafness of white Persian tom cats. I possessed such an one for years which was not deaf; another, in a house near me, is not deaf, and I now have a grand fellow, a true Persian, in possession of all his faculties. A neighbour's pussy having walked into the house, with characteristic Oriental hospitality he went to the larder, and selecting a fish which he doubtless thought would be a *bonne bouche* for his guest, laid it before his friend, and did not himself partake of it.

Trebah, Cornwall, March 31 C. F.

Phosphorescence in Wood

IF some one would be good enough to give me a little information concerning the following (to me novel) phenomenon, he would oblige.

A heap of sticks intended for firing, lay in a corner of our boiler-house, and among them were some round pieces of Scotch fir (*Pinus sylvestris*) about 6 or 8 inches in diameter, and 18 inches long. These had been sawn from a pole which had lain out in the wet, and being consequently rather damp, the cut portions were placed in the warm boiler-house to dry. The blocks I speak of appeared quite sound. From the circumference of three or four of them the bark was rubbed off, here and there in patches, and a few chips were broken away from the edges. The fresh surface beneath was covered with a thin layer of the ordinary sticky resin, which so copiously exudes from this and other trees. When it was dark the steward happened to enter the boiler-house, and looking towards the sticks he was surprised to see a pale steady light emitted by some of them. At first he thought it was the reflection of the moon which shone through the window. Closer examination, however, proved: (1) that the moon did not shine on the sticks at all; (2) that the sticks were self-luminous; (3) that it was only the Scotch fir blocks which emitted any light; (4) that the light was confined to the resinous surface, exposed beneath the bark and chips; (5) that the surface beneath the chips (that is where more than the bark had been removed) was brightest. The steward carried the block which appeared most brilliant to an outhouse, where it still continued to "shine." He then broke off some small loose chips with his fingers from this block, and each separate chip sent forth the same steady pale light. My informant states that the phenomenon was very "curious." Perhaps this species of phosphorescence may not be unusual after all; but not being well "up" in the subject, I would with your permission, sir, merely ask is it common, and if so, how is it explained in the instance I mention? I may state that the steward gave me all the information. I saw the blocks afterwards but not the curiosity. RICHARD M. BARRINGTON

Fassaroe Bray

Indices of Journals

PUBLISHERS of periodicals, scientific or other, issue general indices only after intervals of ten or twenty years. In the ninth or nineteenth year the investigator of bibliography has to turn over every volume, a fearful waste of time. I have consulted with the librarian of this University, and the proposal we have to make is that the publishers should send, at least to the libraries, a duplicate copy of the annual index of each journal, or better a revised proof in slips, to be cut up and pasted into a volume which would thus be annually extended for nine years, and superseded in the tenth by the general index. The addition to the expense in a library is very trifling, and a small payment for the extra copies of the indices would protect the publishers against loss.

Glasgow University JOHN YOUNG

THE DUTCH SOCIETY OF SCIENCES

THE following account of the history of the Dutch Society of Sciences at Harlem has been drawn up by the Secretary, E. H. von Baumhauer, for publication in England. It shows the progress of science in Holland, and the great interest taken in its advancement both in that country and abroad, as proved by the award of so many valuable gold medals, and by the recent establishment of a central bureau for the exchange and transmission of books; all which activity is maintained without any of the expense falling on the scientific members.

In the middle of the last century the greater part of the aristocracy of Harlem were desirous of finding recreation in physical experiments and scientific researches. Along with several regents of the town they decided in 1752 to establish a self-supporting society, for the collection of written essays, and the bestowal of prizes on those of meritorious character. At the first meeting, May 21, 1752, the preacher, C. C. H. van der Aa, was appointed secretary, and many other protectors of the sciences and learned men in other parts of the country, were invited to become members, amongst whom were Musschenbroek, Gambius, Alberti, and others, so that by the end of the year the Society was already formed of twenty-three directors and members. The design was to include all branches of science, and to search for everything necessary for the present and future prosperity of the Republic, both in its internal and external relations, in peace and in war. Even communications on theological subjects were not excluded, treated in such a manner as not to offend Christians of any sect. The motto of the Society was *Deo et Patriæ*. By the help of many wealthy persons the Society was enabled to crown several prize essays, published in the transactions. In July 1754 the protectorate was conferred on the young hereditary governor, William Prince of Orange.

Several very eminent native and foreign men became members of the Society, and the first volume of the Transactions was so favourably received that a second edition was necessary. It was also in great part translated into German. The prize questions excited much interest in other countries, so that several were answered by foreigners. Since 1772 an annual programme has been published in both Dutch and French.

After an existence of twenty-five years the Society founded a sub-division, more specially devoted to commerce, agriculture, and industry, under the name of the Commercial Branch. This was the origin of what was afterwards called the Dutch Society for the Promotion of Industry, which in 1877 will celebrate its centenary festival.

The parent institution continued in a flourishing state until 1780; but the mournful political situation of the country for some time after that had a most injurious effect, so that the very name of this Society was continually changed. From 1798 it was called the Bavarian Society. King Louis called himself perpetual President of the Royal Society of Sciences; but in 1820, by order of the Emperor's Governor, the Prince of Plaisance, the name of the Dutch was again adopted, and has been retained till now. William I. willingly accepted the protectorate, and his example has been followed by his successors.

The Secretary Van der Aa, who had been the soul of the Society from 1751 to 1794, was succeeded by the renowned Physical Professor Martinus van Marum, who at his death in 1837 was succeeded by the Professor of Geology, T. G. S. van Breda, who took his dismissal in 1864, when the Professor of Chemistry, E. H. von Baumhauer, was appointed to the office.

From 1754 to 1793 the Society published thirty volumes of Transactions, of which registers by the celebrated T. T. Martinet were issued in 1773 and 1793. These Transactions contain essays on all branches of science, and also many on theology. It was principally through the influence of Van Marum that since then a more predominating share has been taken by physical subjects. From 1799 to 1844 a first series of 24 volumes in octavo, and from 1841 to 1866 a second series of 25 volumes in quarto, and since 1870 a third series of "Physical Transactions" have been published by the Society. In 1802 a volume in octavo of "Mechanical and Mathematical Transactions" was published, and in 1821 and 1822 two volumes in octavo of "Philosophical Transactions." From 1815 to 1820 three volumes in octavo on literary and archæological subjects, and since 1851 2 volumes of "Historical and Literary Transactions" in quarto have been published. The second and third series of "Physical Transactions" are especially distinguished by the memoirs written by the most eminent men in Europe, mostly illustrated by excellent plates.

The revenue of the Society is derived from the interest of capital, for which it is indebted to the kindness of the directors and from the annual subscriptions of the actual directors. It receives no pecuniary assistance whatever from the Government.

With these means the Society endeavours to make known to the world excellent writings on physical subjects, which otherwise would be published with difficulty on account of their special character and the costliness of the illustrations.

Besides supporting such works, the Society encourages scientific researches, and since 1866 has published a journal in the French language, edited by the Secretary, under the title of "Archives Néerlandaises des Sciences Exactes et Naturelles," of which already 7 volumes have appeared. This journal is destined to make known to the world all that is produced in the Netherlands and the Dutch possessions related to physical science. This is of great service to the Dutch scientific men, since their researches, being for the most part written in a language so little known generally as the Dutch, would otherwise obtain only a very partial publicity.

The Society is composed of an indefinite number of directors, for the greater part gentlemen of wealth and social importance, who pay an annual contribution of fifty gulden (about four guineas) and manage the finances, which, however, now are especially under the charge of five directors living in Harlem, presided over by the president. There are also sixty native and sixty foreign members, who are chosen in the General Assembly, held on the third Saturday of May, from a list of candidates made by the directors and members. These members pay no contribution whatever, and receive free all the publications of the Society. This membership of the oldest and most important Dutch society is esteemed a great distinction by learned men. The English members are Davidson, Davis, Kirkman, Hooker, Lyell, Owen, Sorby, Tyndall, and Wheatstone. The president of the Society is chosen every three years by the directors. At the present time the office is filled by Baron F. W. van Styrum. When a vacancy occurs in the secretaryship, the native members nominate six from amongst themselves from whom the secretary is chosen by the directors. He also acts as treasurer and librarian, and is the only paid officer, living in Harlem in the magnificent building belonging to the Society.

The Society exchanges its publications with almost all the foreign academies and learned institutions, and to facilitate the interchange of books, the Secretary has instituted a central bureau in imitation of the American Smithsonian Institute.

As already named, the Society has regularly published a list of prize questions, the meritorious answering of which is rewarded by a gold medal of the value of about twelve guineas, to which may be added an equal sum or more, in money. At the present time no less than twenty such medals and prizes are offered for an equal number of subjects.

At the centennial festival in 1852 the Society offered a prize of 1000 gulden for the most important work in one of the branches of physics, which should be published during the next four years, and a second of 2,000 gulden for the best in four following years. In the General Assembly of 1857 it was decided that this latter prize should not be bestowed upon anyone, but that M. Foucault should be informed that the Society regretted that his communicated discoveries had not happened in the specified time, but would bestow on him the gold medal as a proof of the high value placed on his researches. On the contrary, the first prize was doubled, on account of the difficulty of deciding between two authors of transmitted works, M. A. Decandolle of Geneva, and Herr O. Heer of Zurich, who were both judged to be deserving of the 1,000 gulden offered to each.

In the general assembly of 1869 the Society resolved that quite independently of the medals bestowed on crowned prize questions, two new medals should be established, of the intrinsic value of 500 gulden (about 40 guineas), one to bear the name and image of Huygens, and the other those of Boerhaave. These medals will be bestowed alternately every two years on learned men in the country or abroad, who shall be thought by the Society to have made themselves particularly meritorious during the last twenty years in a fixed subdivision of the mathematical and physical sciences, by their researches, discoveries, or inventions. The Huygens medal was to be assigned in 1870 to the branch of physics, and will be assigned in 1874 to chemistry, in 1878 to astronomy, in 1882 to meteorology, and in 1886 to pure and applied mathematics.

The Boerhaave medal was to be assigned in 1872 to geology and mineralogy, and will be assigned in 1878 to botany, in 1880 to zoology, in 1884 to physiology, and in 1888 to anthropology; after which the same order will be repeated over and over again in the case of both medals, so that one medal will be given every twenty years for each of ten different subjects. The judgment is to take place by a Commission to be appointed by the directors, of which Commission the Secretary of the Society is always to be a member. The award is to be made in the General Assembly, in accordance with the pre-advice of the Commission, accompanied with a particular account of the motives which have led to the choice.

The first Huygens medal was awarded in 1870 to Rodolph Julius Emmanuel Clausius, Professor at the University of Bonn, as founder of the mechanical theory of heat; and in 1872 the first Boerhaave medal was given to Henry Clifton Sorby of Sheffield, for having made himself particularly meritorious by his microscopical researches in connection with geology and mineralogy, during the last twenty years.

The portrait of Huygens was taken from a copper-plate engraving by Edelink, and that of Boerhaave, from an oil painting by Troost, now in the Academy at Leiden. Independent of their size (3 in. in diameter, 9 oz. troy) both these medals are most creditable to all parties concerned as fine works of art.

ON THE SPECTROSCOPE AND ITS APPLICATIONS

VII.

ANOTHER point was also very obvious to those who are familiar with these inquiries, namely, that if these prominences really consisted of gas, by the use of a powerful spectroscope it was perfectly unnecessary to wait for eclipses at all. The reason for this will be clear on a little consideration; if we take a continuous or unbroken spectrum and apply successively a number of prisms, the spectrum will become proportionately lengthened, and therefore more and more feeble, and in fact we can thus reduce the light to any degree required; if now, on the other hand, we take a spectrum which consists only of bright lines, say of one line in the red and another in the blue, and as before apply successively a number of prisms, we shall, it is true, increase the length of the spectrum, that is the distance between the two lines, but this will be all; the additional prisms have no power to alter the width of the lines themselves, for we have seen that these are simply the images of the slit. Their light, therefore, will only be slightly enfeebled owing to reflection merely. Thus if we have a mixed light to analyse, part of which comes from a source giving out a continuous spectrum, and the rest that of a glowing gas, although when working with a single prism no lines may be visible on account of the brightness of the continuous spectrum, yet by using say five or seven prisms we can so dilute the continuous spectrum as to render the bright lines of the glowing gas clearly visible. The case of the red flames round the sun is a case in point. They are invisible to the naked eye and in telescopes on account of the intensely illuminated atmosphere which also prevents anything like bright lines being observed from these red flames, until the bright continuous spectrum has been much reduced, when this has been done the bright lines of the spectrum, should there be any, will appear on a comparatively dark background. M. Janssen, who was sent out by the French Government to observe the eclipse which was visible in India in 1868, Major Tennant, and others, had no difficulty in recognizing in a moment, when the sun was eclipsed, that these things really did consist of gases or vapours, and M. Janssen, a very careful observer, had no difficulty in determining that the gas in question was really hydrogen gas. M. Janssen and myself were also enabled to determine this by observations on the uneclipsed sun, by means of the new method I have just sketched out. The accompanying woodcut (Fig. 40) shows the spectrum which is observed from these solar prominences. The spectrum of the prominences is shown in the upper, and that of the sun in the lower half of the engraving. This method is very easy to understand if you bear in mind the engraving of the spectroscope for solar work, and recollect that when we wish to examine the regions round the sun, the light of the sun is allowed to fall on the slit in such a way that one half of the slit at the focus of the object glass of the large telescope is occupied by the brilliant image of the sun, and the other half is fishing, so to speak, around the limb or edge of the sun, so that if there is anything at all around the limb, the spectroscope, in the—to the eye—unoccupied part outside the image, picks up this something, and gives us its light sorted out into its proper bright lines in the spectrum. This spectrum shows that there is first a bright line, Fig. 41, in

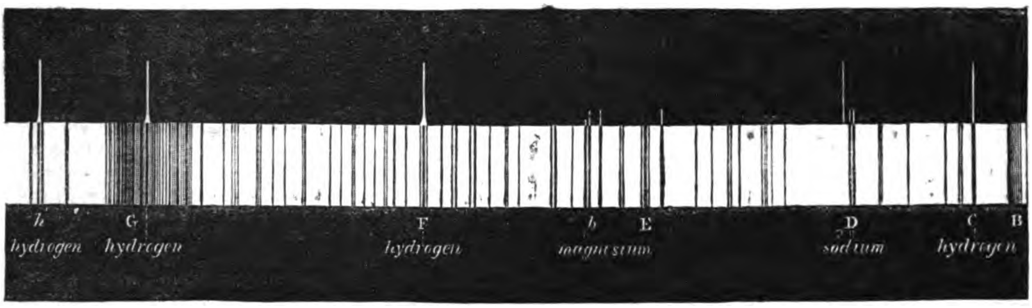

FIG. 40.—Spectrum of the Sun's Photosphere (below) and Chromosphere (above).

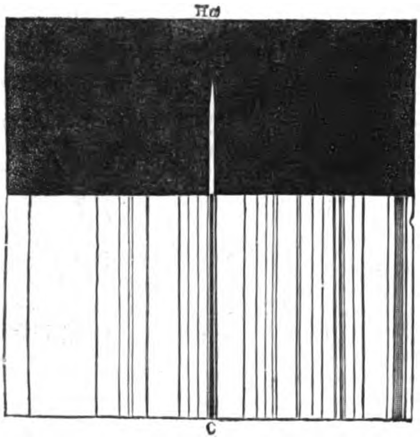

FIG. 41 — C line bright in chromosphere, dark in sun.

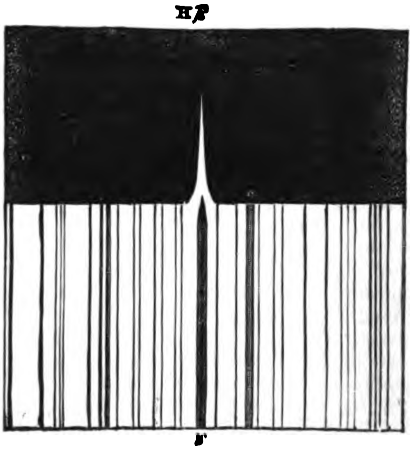

FIG. 42.—F line in chromosphere, showing widening near the sun.

the red, marked C, which is absolutely coincident with a prominent dark line in the solar spectrum. Now this is a black line which, by repeated observations, we know corresponds in degree of refrangibility exactly with one of the lines given out by glowing hydrogen, when examined in one of these tubes with the electric spark. When, therefore, we get any substance around the sun reporting its light to us, it is perfectly obvious, I think, that if the bright line really be coincident with this dark line, that something is probably hydrogen. This was one of the first lines determined by M. Janssen in the eclipse of 1868. There is another bright line absolutely coincident with a dark line known to correspond in refrangibility with another line given out by hydrogen in the green part of the spectrum, marked F in the figure. This, then, is further proof in favour of hydrogen; and now notice a great difference between the shape of this line and the red line which I drew your attention to just now. An enlarged representation of this line is shown in Fig. 42.

You will bear in mind what I told you about the effect of pressure in altering the spectrum of hydrogen, and that one of the most obvious effects of increased pressure was to increase the thickness of what is called the F line—the line now under consideration, you will see here that the widening of the F line, the green line of hydrogen, really indicates a thickening due to pressure. In that way we have been able to determine approximately the pressure of these circum-solar regions which the spectroscope has determined to be occupied by an envelope of hydrogen gas, mingled sometimes with other vapours, which envelope I have termed the chromosphere. When the pressure of the chromosphere is completely determined, we shall be probably enabled to determine the temperature of the sun.

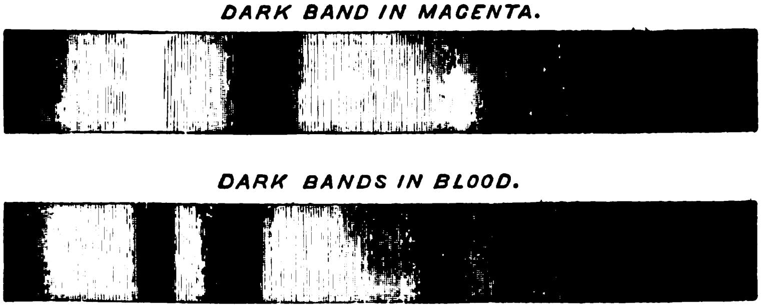

Fig. 43.

A line again in the violet corresponds with a dark line in the solar spectrum, which is coincident with a third line of glowing hydrogen which we have before spoken about, and there is still another coincident line. A line in the yellow of the spectrum will also be noticed. This is one which has caused a great deal of discussion, for it is not coincident with any line of any known terrestrial substance. A number of short lines are also shown in the engraving which will be seen to correspond to the part of the chromosphere which is denser, for then the F line of hydrogen has become broad where these lines are seen; these lines show that in the layers of the chromosphere nearest to the sun a number of other substances exist, amongst which may be mentioned magnesium, iron, and sodium. The reason that bodies do not reach up so far from the body of the sun is that their vapours are very much heavier than the gas hydrogen, which is the lightest terrestrial substance known. Such are a few of the practical applications of the spectroscope as applied to the radiation of light. There are other classes of facts relating to the absorption of light, on the consideration of which we shall now enter.

The subject with which we have just been dealing is the radiation or giving out of light by bodies in different states—that is to say, by solid or liquid bodies, or gaseous or vaporous ones. We have now to deal with the action of the prism upon light under some new conditions—conditions which I purposely withheld from you in the last lecture. Light is not only given out, or *radiated*, but it may be stopped or *absorbed* in its passage from the light-source to our eye, if we interpose in the path of the beam certain more or less perfectly transparent substances, be they solids, liquids, gases, or vapours. I will recall one or two of the experiments which have been already described in order that you may see exactly how the perfectly distinct classes of phenomena due to radiation and absorption really run together. You will recollect that I pointed out to you that radiation, or the giving out of light, might be continuous or might be selective, and I am anxious now to show you that radiation is exactly equalled by absorption in this matter; that absorption may also be continuous or selective. We have before taken as an instance of continuous radiation a continuous spectrum obtained by using the electric lamp or a lime-light; that is to say, an example of the general radiation which you get from an incandescent solid—the carbon points of which the poles of the lamp are composed, or the solid lime. You will remember that if we take the spectrum of a vapour—as, for instance, that of strontium or thallium—we find that the continuous spectrum is altogether changed, and that in the place of that beautiful rainbow band, continuous from the red end of the spectrum to the violet, we really only get lines here and there, which are due to the selective radiation, and opposed to the general radiation which we spoke of in the continuous spectrum just now. I might have chosen other substances besides strontium and thallium, but I mentioned the spectra of these substances when we were considering the question of radia-

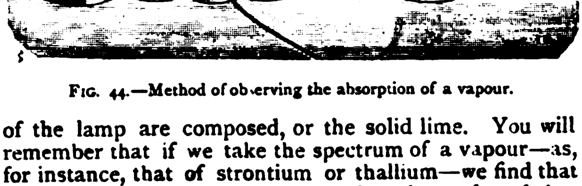

Fig. 44.—Method of observing the absorption of a vapour.

tion. What I have to dwell on now is, that the absorption or sifting of light by different bodies is very like radiation in its results—that is to say, in some cases we have an absorption which deals equally with every part of the spectrum, and in other cases we have absorption which only picks out a particular part of the spectrum here and there to act upon. But there is one important point to be borne in mind; when dealing with absorption we must always have a continuous spectrum to act upon. If we had a discontinuous spectrum to act upon, the thing would not be at all so clear. Having this continuous spectrum, the problem is, what the action of the different substances on the light will be. Let me give you an instance of general absorption. If we take the continuous spectrum above referred to, and interpose a piece of smoked glass, or better, a piece of neutral-tint glass, you will find that the substance will cut off the light and deaden the spectrum, so to speak, throughout its whole length. This neutral-tinted glass, then, has the faculty evidently of keeping back the light, red, yellow, blue, green, violet, and so on; and is an instance of general absorption. A very dense vapour would furnish us with another similar instance. Now, instead of using the neutral-tint glass, we will introduce a piece of coloured glass, the action of which, instead of being general throughout the spectrum, will be limited to a particular part of it. I have now interposed a piece of red glass, which cuts off nearly all the light except the red; and now I interpose a piece of blue glass, which cuts off everything except the extreme violet. By introducing both these pieces in the beam, the spectrum is entirely obliterated.

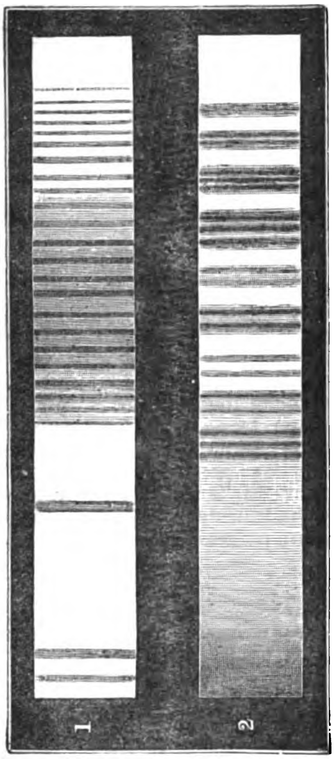

FIG 45.—Absorption spectra of iodine and nitrous fumes.

In these latter cases we have instances, not of general, but of selective absorption, one substance cutting off everything but the red, and the other cutting off everything but the violet. Now the fact that we can absorb any definite part of the spectrum by properly tinted glasses provides us with a practical application of spectrum analysis in the manufacture of the coloured glass used for lighthouses or signals. Further, if astronomers could find a glass of a certain red, or a glass of a certain green colour, we should be able to see the solar prominences every day without a spectroscope.

The first practical application which springs out of these phenomena of absorption is this, that as different substances are known by the effects which they produce on radiation, so also chemists find it perfectly easy to detect different substances by means of their absorption; for instance, the absorption spectrum of nitrous fumes can be shown by taking first our continuous spectrum, which we must always have to start with, and introducing some nitric peroxide between the source of light and the prism. The nitric oxide, immediately it comes in contact with the air, produces dense red fumes, and numbers of fine black lines will be seen immediately crossing the spectrum at right angles to its length, and to a certain extent resembling the solar spectrum with its Fraunhofer lines. Iodine is another substance which gives a coloured vapour, the absorption spectrum of which is very definite and well defined. Fig. 45, Spectrum No. 1, shows the absorption spectrum of iodine vapour, and No. 2 that of nitrous fumes. We are not limited to these substances; we will try something else—blood, for instance, about which I shall have something more to say presently. We shall find that the action of blood upon the light is perfectly distinct from the action of those fumes which we have spoken of; and instead of having typical lines in the green and blue parts of the spectrum, we have two very obvious lines in the more luminous part of the spectrum. The colour of a solution of blood is not unlike the colour of a solution of magenta; but if, instead of using a solution of blood, we use a solution of magenta, we should have only a single black band. The absorption spectrum of potassic permanganate solution is another beautiful instance. We have here something totally unlike anything we had before. Instead of the two dark bands which we saw in the case of the blood, or the single band in the case of magenta, we have four very definite absorption bands in the green part of the spectrum. So that you see the means of research spectrum analysis affords as far as regards radiation, is entirely reproduced in the case of absorption, and it is perfectly easy, by means of the absorption of different vapours and different substances held in solution, to determine not only what the absorbers really are, but to determine the presence of an extremely small quantity. Further, by allowing the light to pass through a greater thickness of the absorbing substance, the absorption lines are thickened and new regions of absorption are observed. This fact was discovered by Dr. Gladstone, who used hollow prisms containing the substance.

J. N. LOCKYER

(*To be continued.*)

PROFESSOR ZOLLNER ON THE CONNECTION BETWEEN COMETS AND METEORS

PROFESSOR F. ZÖLLNER alludes in the commencement of his paper read before the members of the "Kön. Sächs., Gesellschaft der Wissenschaften" to the epoch which Schiaparelli's discovery of the concordance of the orbits of some small comets with those of periodically returning showers of shooting stars has made in the astronomical world. He quotes an instance in proof of this, namely, Biela's Comet. On November 27, last year, the earth was crossing the exact spot in her orbit, which had been cut by Biela's Comet two and a half months before. Observers aware of the coming event were on the alert with their instruments, but no good results were obtained owing to the unfavourableness of the weather.

From these facts, he says, we must naturally conclude that the physical constitution of these bodies is the same, and we are strengthened in our conclusions by Schiaparelli's discovery of the identity of the envelopes and tails of comets with clouds of meteors seen by reflected sunlight, the separate elements of which only become visible at a shorter distance.

Observations, however, with the spectroscope, contradict this assumption; the light given out by comets is found not to correspond with that of the sun; it is a light peculiar to them, like that of a glowing gas.

Further on he quotes Schiaparelli's own words to some length, with respect to the attraction exercised by other bodies on the matter composing the nuclei of comets, which is drawn from them in directions other than that of their orbits. Schiaparelli maintains most distinctly that the tails of comets and meteoric aggregates are not identical.

Professor Zöllner points out that if we are not to suppose that the physical constitution of both phenomena is the same, there only remains their identity of origin as an explanation of the remarkable coincidence of these bodies in space. Pursuing this argument and accepting its veracity, there is no reason to disbelieve the materials of which they are formed, to be the same. Schiaparelli supposes the nuclei of comets to consist of a solid substance, which being subject to a kind of "weathering process," finally becomes broken up into separate pieces, which are turned into a meteoric swarm by the attraction and atmospheric resistance of a large planet. To this effect he again quotes Schiaparelli. Further on he expresses it as his opinion that comets and meteorites are the remains of planets, the former being their fluid and the latter their solid constituents. It must be left to future observers to decide whether the apparent disappearance of Biela's comet has any connection with the rich fall of stars observed on November 27, last year.

It is possible that the vapour left in consequence of the gradual evaporation of a comet would condense, in the absence of any powerful centre of attraction, into a number of separate centres, as a cloud is dissolved into raindrops on the increase of cold. In this way the condensed portions of cometary vapour would present the phenomenon of numerous shooting stars as they penetrate the earth's atmosphere in a solid or perhaps still fluid condition.

PHYSICO-CHEMICAL RESEARCHES ON THE AQUATIC ARTICULATA *

IN NATURE, vol. iv. p. 245, we gave a brief notice of some investigations M. Plateau had been making on the above subject. Since that time he has been continuing his researches in the same direction, and sends us an abstract of the results so far as concerns three problems in the life of aquatic Articulata.

I. Experiments to ascertain the length of time that aquatic insects can remain under water without coming to the surface to breathe.

The swimming aquatic Articulata which breathe air come frequently to the surface to renew their supply. The questions, How long may they with impunity remain submerged? what is their power of resisting asphyxia, as compared with that of terrestrial insects? are answered by the following experiments. At the bottom of an open vessel, of one litre capacity, full of ordinary fresh water, is placed a very small vessel, containing about 200 cubic centimetres. A piece of cotton netting so covers the mouth of the latter, that an insect, placed in the small vessel, is in reality in the general mass of the water, but cannot ascend to the surface. Terrestrial insects placed in these conditions, impelled by their specific lightness, rise to the lower surface of the network; the movements of their legs soon cease, they do not appear to suffer, and they quickly grow torpid. The Coleoptera and aquatic Hemiptera, on the contrary, instead of submitting passively to their fate, endeavour to quit their prison, swim rapidly about, exert themselves to come to the surface, and keep struggling until their strength is enfeebled, and end by lying at the bottom as if dead.

In order to recover from its state of general torpidity an insect which has been submitted to prolonged immersion, it is necessary, after having taken it out of the water, to place it upon absorbing paper. If the time of its immersion has not passed a certain limit, the animal gradually recovers its energy, retaining no sensible trace of the experiment to which it has been submitted. M. Plateau repeated the experiment upon many individuals and for various lengths of time, for the purpose of discovering, in the case of each species, the limit of time beyond which immersion caused the death of the insect. He arrived at two curious conclusions, supported by a great number of trials :—

1. The terrestrial Coleoptera recovered from complete submersion continued for a very long time, in several cases for 96 hours. 2. The aquatic swimming Coleoptera and Hemiptera, far from presenting a greater resistance to asphyxia by submersion than the terrestrial insects, in most cases succumbed very much sooner.

The cause of this unexpected inferiority in the case of the aquatic insects M. Plateau thinks is due exclusively to their greater activity in the water, causing as a consequence a more rapid loss of oxygen.

II. Influence of Cold : Effects of Freezing.

The results of M. Plateau's experiments in this direction are that the aquatic Articulata of the latitudes of Belgium exist for an indefinite period in water maintained at zero (centigrade) by means of melting ice; while they cannot remain alive in ice for any length of time—not for half an hour at the utmost. The latter phenomenon appears to be accounted for by the fact that the insects are completely deprived of all power of motion, thereby losing completely their animal heat.

III. Action of Heat.

Under this head M. Plateau tries to show the maximum temperature of water in which fresh-water Arachnoids can live. He finds that the highest temperature they can endure without injury oscillates between 33°·5 and 46°·2 centigrade. Comparing these results with those which have been obtained by experimenting with animals belonging to other groups, M. Plateau finds that the greatest temperature which aquatic vertebrata, articulata, and molluscs can support probably does not exceed 46° centigrade.

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* By M. Felix Plateau.

NOTES

WE have received a communication from Dr. Rein, Director of the Leenckenberg Society of Naturalists at Frankfort, which amusingly illustrates the perils that accompany the honours of the translation into a foreign language of a scientific work. Our informant relates that the well-known publisher, M. R. Oppenheim, of Berlin, having recently obtained the sanction of Mr. Poulett Scrope for the publication of a German translation of his work on "Volcanoes," of which a new issue lately appeared in this country, confided the work of translation to Prof. G. A. von Klöden, who accordingly performed the task. The translation was printed, together with a preface written by M. von Klöden himself—which preface, in the hurry of business, and in reliance, of course, on the good faith of the translator, the publisher forebore from examining. The volume in due course appeared, and was circulated by the publisher; and not till then was it discovered that the preface aforesaid consisted of a severe and indeed bitter critique of the work to which it was prefixed, and of the author's views as therein stated of the theory of volcanic energy, and its external development in the formation of cones and craters, &c. The explanation is that Prof. von Klöden happens—unluckily for the author whose work he undertook to translate—to have been all his life an earnest advocate and teacher of the famous "Erhebungs-Krater," or "upheaval crater" theory of Humboldt and Von Buch, which Mr. Scrope, together with Sir C. Lyell, Constant Prevost, and other geologists have persistently opposed, and are, we believe, generally considered to have satisfactorily refuted. Of course it is open to Prof. von. Klöden to expound and defend his own opinion on this subject to the fullest extent in any independent publication; but it does seem to be stretching the liberty of free expression on scientific questions in an unprecedented manner, when a gentleman employed to translate a scientific work takes advantage of the opportunity to append to the translation, in the disguise of a preface, a pamphlet of nineteen pages containing an elaborate refutation, according to his own ideas, of the bulk of the views contained in the work itself. Mr. Scrope, we understand, on becoming aware of this strange conduct of Prof. von Klöden, has endeavoured to meet the attack thus unfairly made on his work, by circulating as widely as possible through the scientific world of Germany, a translation of his essay on the formation of volcanic cones and craters, originally read before the Geological Society of London in February 1859, and published in the journal of the Society for that year, a paper in which the theory of "Erhebungs-Kratere" was amply discussed. But even here the author appears to have had but scant justice done to him, if it be true, as Dr. Rein assures us, that "the German of this translation is *very bad!*"

AN Icelandic gentleman sends to the *Scotsman* an account of the eruption of the Skaptar Jokull in Iceland, which took place in January last. On January 9, about three o'clock A.M., there was observed from Reykjavik a great fire in the E.N.E. The fire shot up like lightning, displaying beautiful evolutions in combination with the electricity above. So bright was it, that during the dark morning hours it was thought it must be very close to Reykjavik. But when daylight dawned, and the mountains could be discerned, a thick and heavy column of vapour or steam was observed far in the background, beyond all the mountains, so that it was clear that it was far off, and, according to the direction, it seemed most likely to be in Skaptar Jokull, the west part of Vatna Jokull—the great waste of glaciers in the east and south of the island. Morning and night this grand display was visible during the 9th, 10th, 11th, and 12th, and during the day the column of steam and smoke stood high in the sky. All agreed that the eruption must be in Skaptar Jokull, and from various observations it was concluded that the position of the crater ought to be between 67° 7′ and 67° 18′ deg. north lat., and 30° 45′ and 30° 55′ west long. from the meridian of Copenhagen. In the east, near Berufjord, some shocks were felt, and fire was seen from many farms. Ashes, too, had fallen over the north-east coast so abundantly that pasture fields were covered, and the farmers had to take their sheep into the huts and feed them. In the south, however, no earthquakes were felt, or noises heard in the earth, as far as Markarfljol (near Eyjafjalla Jokull). Nowhere has been observed any fall of ashes or dust, but all aver a bad smell was felt, which was also the case in Reykjavik on the forenoon of the 10th. At Reykjavik the air was felt to be very close, with a smell of sulphur and powder. No change was observed in the sun, moon, &c. The sky was clear all these days. The direction of the wind was from N.W.—W.S.W., and the weather fine.

BARON LIEBIG is seriously ill, and on the 15th inst. there had been a great change for the worse in his condition.

ON Tuesday, Dr. James Murie, late Prosector to the Zoological Society, was unanimously elected by the Town Council of Edinburgh, Professor of Anatomy and Zootomy to the Veterinary College of that city, *vice* Professor Davidson, M.D., deceased.

PROF. ANSTED, whose unfortunate accident we noticed last week, has recently received from the King of the Greeks the brevet and insignia of the Hellenic order of the Sauveur, of which he has been nominated an officer, in recognition of his services in reference to the Laurium question.

M. LOEWY has been elected a member of the French Academy of Sciences in room of the late M. Delaunay.

A COMMITTEE was formed last autumn with a view to secure some provision for the five children who were left unprovided for by the untimely death of Mr. John Cargill Brough. A meeting of this Committee was held at the London Institution on Tuesday last, and the report of the Honorary Secretaries showed that the subscriptions amounted to a sum which, after deducting all expenses, will stand at nearly 2,000*l.* In this sum are included a grant of 150*l.* from the Royal Bounty Fund, 200*l.* contributed by members of the Savage Club, and nearly 400*l.* collected in answer to an appeal to the Pharmaceutical Chemists. A deed of trust of the usual character was approved by the Committee, and trustees were appointed. Votes of thanks were passed to Mr. McArthur, M.P., who has given a presentation to Christ's Hospital, to Mr. Deputy Webster, and to Sir John Lubbock, Bart., M.P., F.R.S., who has kindly acted as treasurer of the fund. The secretaries stated, in concluding their report, that the names of the gentlemen who have acted on the Committee, as well as the kindly expressions of sympathy which have from time to time reached them, afford evidence of the respect and affection in which Mr. Brough's memory is held.

AMONG the candidates for the Professorship of Anatomy to the Royal Academy are Dr. B. W. Richardson, F.R.S., and Mr. John Marshal, F.R.S.

DR. B. W. RICHARDSON, F.R.S., has been elected by the President and Council of the Royal Society, Croonian Lecturer on the subject of muscular motion.

THE third part of the great map of Switzerland ("Topographischer Atlas der Schweiz"), containing the sheets Binnenthal, Helsenhorn, Andermatt, Six Madun, S. Gotthard, Faido, Olivone, Hinterrhein, Mesocco, Jungfrau, Adelboden, and Lenk, has recently been issued at Berne. These sheets are all on the scale of $\frac{1}{50000}$. Those called Andermatt and S. Gotthard have a special and general interest at the present time from embracing the course of the Great St. Gotthard tunnel, and exhibit in the clearest manner, by means of their contour lines, the nature and altitudes of the overlying land. Thirty-eight sheets are now published out of the 546 which will compose this magnificent map.

MR. E. L. LAYARD, H.M. Consul at Para, well known for his zoological researches in different parts of the world, has returned to England, resigned his consulate in that place, and accepted the charge of the British interests in the Fiji Islands. During the short time he has held his office in South America, he has made a valuable collection of birds, of which we understand an account will be given in one of the forthcoming numbers of the *Ibis*.

THE new gate to the Zoological Society's Gardens in the Albert Road, opposite Primrose Hill, and the new canal bridge, opened on Easter Monday for the first time, were found very convenient to those of the 42,320 visitors on that day who arrived from the north, as they were saved the trouble of going over the rather out-of-the-way bridges of the Regent's Canal, which they previously had to do.

WE understand that Mr. Severzow, a well-known Russian naturalist of Moscow, is preparing a work on the zoology of the vertebrata of Turkestan, which will be accompanied with illustrations of the new and interesting species which have been the first-fruits of the new Russian Expedition and Annexations in that part of Asia.

THE Lucasian Professor of Mathematics (Mr. Stokes) at Cambridge, will deliver a course of lectures on hydrostatics, hydrodynamics, and optics, commencing Friday, April 25, and they will be continued, with a few exceptions, on all week days except Thursday, at the hour of 1 P.M., in the New Museum. Gentlemen who wish to attend are requested to leave their names with Messrs. Deighton. Mr. J. W. Clark will commence his osteological demonstrations in the Museum of Zoology and Comparative Anatomy, on May 12. The Demonstrator of Comparative Anatomy will resume his class for practical work on May 1, and continue the same on Thursday, Friday, and Saturday. Courses of lectures on History, Languages, and the various sciences, will be delivered at Cambridge to women during the Easter Term. The fee for each course is one guinea, but a reduction of one-half may be obtained on application by persons engaged in or preparing for the profession of education.

We hear that a Natural History Society and Field Club is about to be formed among the members of the Working Men's College, Great Ormond Street. The list of classes in the College for the term commencing April 21, announces a series of Saturday afternoon geological excursions, under the guidance of Mr. Logan Lobley, F.G.S. A course of lectures in Physiology is to be begun by Mr. S. D. Darbishire, M.A., Ball. Coll. Oxf. Mr. T. Hughes, M.P., who is now the Principal, will preside at the meeting with which the term opens on Monday evening next, and to which the public are admitted.

We have received from Prof. Cope several photographs of the cranium of the hugh horned Proboscidians of Wyoming, named by him *Loxolophodon cornutus*. This genus differs from *Dinoceras* of Marsh, which it very closely resembles in all respects, in having the nasal horn cores flat and horizontal, overhanging the apices of the nasal bones. The maxillary horn cores are also proportionately longer, and are not a continuation in direction of the enormous canine teeth, but are turned somewhat forward. Prof. Cope divides the short-footed Ungulates, or Proboscidians of the North American Eocene, into two families, the Eobasiliidæ and the Bathmodontidæ, the former possessing no incisors and no third trochanter to the femur, the latter having the full complement of incisors and a rudimental third femoral trochanter. He further divides up the Eobasiliidæ into the genera Loxolophodon, Eobasileus, Uintatherium, and Megaceratops, and the Bathmodontidæ into Bathmodon and Metalophodon. From a comparison of the photographs above mentioned with Prof. Marsh's drawing of *Dinoceras mirabilis*, we fail to see any points sufficient to justify their generic separation. On photograph shows clearly that in the molar teeth the outer wall was not present, and that the transverse ridges were fully developed, being straight but not parallel, meeting on the inner border of the tooth to form a >-shaped surface.

The Museum of Comparative Zoology, of Cambridge, U.S., in addition to the Bulletin of its proceedings, issues a series of "Illustrated Catalogues," in small folio form. In this several valuable papers have already appeared; but by far the finest and most important is one just out of press entitled "A Revision of the Echini," by Alexander Agassiz. This embraces an exhaustive account of the bibliography of the subject, as well as its synonymy, followed by detailed descriptions of the genera and species, both as regards the external form and internal anatomy. It is illustrated by forty-nine plates, of which seven represent the geographical distribution of the various groups of *Echini*, the remainder being devoted to representations of the species. A very important experiment has been made in this work as to the availability of different methods of photographic printing for natural history work, and, we may indeed say, with complete success. About one-third of the illustrations of species are crayon drawings on stone, one-third are Albert-types, prepared under the direction of Mr. E. Bierstadt, of New York, and the remainder are Woodbury-types, executed by Mr. John Carbutt, of Philadelphia. Nothing can exceed the perfection of finish and detail of the plates prepared by both these methods, and we are sure the work will mark an era in the history of scientific publications. The expense of even an approximation to the accuracy of these figures, on stone or metal, would have been enormous.

The Special Correspondent of the *Daily News* on board the *Challenger*, writing from St. Thomas on the 24th ult., states that the vessel was to proceed on her voyage that afternoon. All the scientific staff had been busy, and a large collection of interesting and beautiful objects had been made. On the previous Saturday morning the *Challenger* stood out to sea for the purpose of making magnetic observations, returning in the afternoon, and mooring in the inner harbour in readiness to sail the next day. Late in the evening, however, the *Challenger* acted the Good Samaritan to a dilapidated ship and her crew, lying fifteen miles off.

Professor Agassiz sends us part of the correspondence which took place between himself and Mr. Anderson, the gentleman who made the princely gift of a beautiful island and 50,000 dollars to Prof. Agassiz, referred to in the letter from a New York correspondent in last week's Nature. The whole affair has been gone about in the most simple and modest way by Mr. Anderson, who, in a letter to the Professor, hopes the school to be established on Penikese Island "may be destined in future ages not only to afford the required instruction to the youth of our own country, but may be the means of attracting to our shores numerous candidates from the Old World, who may find here, in the school to be established by you, those means of fitting themselves for the teaching of Natural History by Nature herself, which, by a strange oversight, appear to have been overlooked in the schemes (generally so well conceived and executed) of education there."

The course of twenty-four lectures on Zoology, given during the past winter by Mr. J. E. Taylor, F.G.S., in the Museum, Ipswich, has been a great success. Every Friday night the great hall and galleries have been crowded, the audiences increasing as the lectures advanced, so that latterly upwards of 500 people have been in the habit of attending—a very satisfactory audience for a town of the size of Ipswich.

M. Faye has written to contradict a report in the *Revue Scientifique* that he had demitted his post of President of the Commission on the Transit of Venus, because he saw that the necessary instruments would not be ready in time. He was compelled to take this step on account of his many other public duties, and declares that he has no doubt whatever of the success of the French preparations.

M. Boillot, in making some experiments with ozone, has discovered that a litre of pure oxygen yields only 7 milligrammes of ozone, while the same quantity of air gives 37 milligrammes. Thus, *Les Mondes* says, oxygen mixed with air is in a condition more favourable to its being converted into ozone.

According to the *American Artisan*, measures are pending at Washington seeking to secure an international coinage of silver, for the immediate use of nations in America and Europe, now embracing a population of more than one hundred and sixty millions, and for the eventual use of all the civilised countries of the world.

Mr. W. F. Denning of Bristol sends us the following meteorological notes. A correspondent writes him that, on November 27, 1872, he was in latitude 43° 24′ north, and longitude 13° 55′ west, when at about $5^h\ 30^m$ to 6^h he witnessed a magnificent shower of meteors, which continued without intermission till nearly 8^h. Most of them were colourless, but some were tinted with a pale bluish hue. The seeming directions were from about N.E. by E., true, to S.W. by W., but the sky appeared so full that it was hard to tell. On April 6, at $9^h\ 8^m$, a meteor nearly as bright as Venus was observed by Mr. Denning at Bristol. Beginning of observed path = R.A. 83°, D. 43° +, end of ditto = R.A. 56°, D. 31° +, length of path = 24°. Duration 1·5 sec. Mr. Denning observed displays of aurora borealis on the evenings of April 1 and 2. On April 1 it was first noticed at $8^h\ 49^m$, when an intense auroral glow pervaded the N. sky and gave an effect similar to moonrise. At $8^h\ 51^m$ a broad streamer became visible, reaching a height of 11°. This streamer was situated 2° N. of β Cassiopeiæ, and appeared to be connected with an auroral arch under Cassiopeia, running from N.W. to N. On the following evening, April 2, the auroral light was again intense in due N.

THE additions to the Zoological Society's Gardens during the last week include a Bacha Eagle (*Spilornis bacha*) from Malacca, presented by Mr. W. Jamrach; a Madagascar Porphyrio (*Porphyrio Madagascariensis*) from Madagascar, presented by Miss Furlonger; a Cuttle-fish (*Octopus vulgaris*) presented by the Brighton Aquarium Co.; a great grey Shrike (*Lanius excubitor*) presented by Mr. Hawkins; a Crested Pelican (*Pelecanus crispus*) from S. Europe, presented by Dr. Doyle; a Vulpine Phalanger (*Phalangista vulpina*); a great Kangaroo (*Macropus giganteus*); a yellow-footed rock kangaroo (*Petrogale xanthopus*); and some Tibetan Wolves (*Canis laniger*) born in the Gardens; two Hunting Crows (*Cissa venatoria*) from India; a Cocoi Heron (*Ardea cocoi*) from the W. Indies; a Broad-banded Armadillo (*Xenurus unicinctus*) from Brazil; two Rock Whiting; a Whiting Pout, two Lump-fish, and six Bream all purchased.

ON AN AIR-BATTERY*

THIS battery is founded on a reaction, brought by the authors before the Royal Society† last spring, in which it was shown that if pieces of copper and silver, in contact, were immersed in copper nitrate solution in presence of oxygen, a deposit of cuprous oxide took place on the silver plate with a corresponding solution of the copper plate, resulting from the decomposition of the copper nitrate in the manner shown in the following formulæ:—

Before contact is made

$$m\mathrm{Ag} \;\mid\; \mathrm{O} \;\mid\; \mathrm{Cu2NO_3} \;\mid\; \mathrm{Cu2NO_3} \;\mid\; n\mathrm{Cu}$$

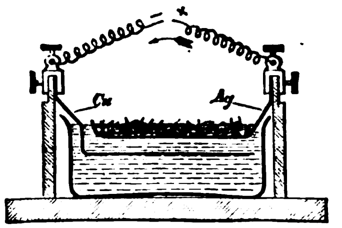
After contact

$$m\mathrm{Ag} \;\mid\; \mathrm{Cu_2O} \;\mid\; \mathrm{Cu2NO_3} \;\mid\; \mathrm{Cu2NO_3} \;\mid\; (n-2)\mathrm{Cu}$$

It is evident that this action is continuous until either the copper or the oxygen is exhausted.

It was stated in that paper, that a galvanic current passed through the solution from the copper to the silver, and also that this was only one case of a large class of similar reactions.

The battery takes the form of a shallow circular vessel containing the solution, and the plates are arranged horizontally, the silver plate being at the surface. It will be apparent on glancing at the above equations, that the combination of the oxygen only takes place in the neighbourhood of the silver; hence it was evidently desirable to increase as much as possible the proximity of the silver plate to the air, and also the surface exposed by the silver. This was accomplished as shown in the adjoining sketch. The silver has the form of a shallow tray, full of crystals of silver, and perforated to allow the circulation of the copper solution. The tray is arranged so that the crystals should just rise above the surface, and being, of course, always wet, they very much increase the absorbing surface of the liquid. The whole arrangement is put upon a wooden stand, and the plates are attached to two uprights fixed in the stand.



The strength of the copper nitrate solution is 6 per cent. This gives about the maximum of effect; a 24 per cent solution gives only half the current; and a 30 per cent solution gives two-thirds. A solution stronger than 6 per cent. is also apt to produce a deposit of subnitrate instead of suboxide.

The best proportionate areas of the silver and copper plates was investigated in two series of experiments, in one of which the silver remained the same, while the copper surface was diminished by varnishing, and in the other set the copper remained the same while the silver was diminished. The following table gives the results in the latter case. The deflections are those of a Thomson's galvanometer:—

Proportion of Surfaces.		Deflection.		
Copper	Silver.	Expt. 1.	Expt. 2.	Expt. 3.
1	0·25	—	—	7°·5
1	0·5	—	—	16°·0
1	0·75	—	—	21°·0
1	1·0	33°	32°	28°·0
1	1·33	41°	40°	—
1	2·0	56°	54°	—
1	4·0	96°	92°	—

It thus appears that an increase in area of the silver plates causes a proportionate increase in the current. It was also found that heat greatly increases the activity of this cell, a cell giving a deflection of 40 at 20° C., gave one of 250 at 50° C.; and the increase in the higher degrees of this range of temperature was much greater than in the lower.

From the nature of the reaction it might be expected that the current would gradually diminish on account of the using up of the oxygen in the neighbourhood of the silver. Such a diminution always does take place at first—agitating the liquid ought, under these circumstances, to increase the action. It does so.

It might also be expected that upon breaking contact for some time, so as to allow oxygen to diffuse itself from other parts of the solution, the current upon again making contact would be as strong, or nearly so, as before. This also was found to be the case.

An experiment was made by putting a cell, with plates connected by a wire, under a bell-jar full of air over mercury. It was expected that the mercury would rise inside the jar from absorption of the oxygen. The mercury did rise, and the oxygen was so completely removed that a lighted taper was immediately extinguished in the remaining gas. The apparatus used in this experiment was exhibited to the Royal Society.

Comparative experiments were made with aërated and deaërated copper nitrate solution. It was found that the amount of action in the latter case was little or nothing, and what small action there was was clearly attributable to the difficulty of completely excluding air.

Two experiments were made alike in all respects, except that in one case the cell used was filled with a solution simply deprived of oxygen, while the other cell was filled with a solution through which a current of $\mathrm{C\,O_2}$ was passed for some time. The first was placed in the air, and gave a deflection of 110 rising to 115, but the second was placed in a vessel full of carbonic acid gas, and gave a deflection of 20, which gradually fell to 3.

It was proved experimentally that the cuprous oxide deposited on the silver was compensated by an equivalent solution of the copper plate. The cuprous oxide is sometimes deposited in crystals visible to the naked eye, and shown by a lens to be regular octahedra.

One cell having plates two inches in diameter was found sufficient to decompose such metallic salts as the nitrates of copper, silver, and lead, platinum being used for the negative electrode, and for the positive the same metal as existed in the salt experimented on. Six cells were sufficient to decompose dilute sulphuric acid and dilute hydrochloric acid pretty quickly, copper electrodes being employed.

The theoretical interest of this battery lies in the fact that it differs from all other galvanic arrangements, inasmuch as the binary compound in solution is incapable of being decomposed either by the positive metal alone or by the two metals in conjunction, without the presence of another body ready to combine with one of its elements when let free.

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* Abstract of paper read at the Royal Society, Thursday, April 3, by J. H. Gladstone, Ph.D., F.R.S., and Alfred Tribe, F.R.S.

† Proc. Roy. Soc. vol. 20, p. 290.

Grove's gas battery is essentially different from this, if the oxygen and hydrogen condensed on the platinum plates play the part of the two metals; but it closely resembles this if hydrogen acts the part of the positive metal, and platinum that of the negative; the dilute sulphuric acid will then be decomposed on account of the simultaneous presence of the oxygen which can combine with the liberated hydrogen. Viewed in this manner, Grove's gas-battery is only a special case of the reaction mentioned in the communication to the Royal Society, and the formulæ will be—

Before contact—

$$\mathrm{m\,Pt} \mid \mathrm{O.} \mid \mathrm{H_2\,S\,O_4} \mid \mathrm{n\,H}$$

After contact—

$$\mathrm{m\,Pt} \mid \mathrm{H_2O} \mid \mathrm{H_2\,S\,O_4} \mid \mathrm{(n-2)\,H.}$$

The practical interest of this arrangement lies in the fact that it is an approximation towards a constant air-battery. Should it ever come into use it would, of course, not be in the form described in this paper, but probably in a combination of copper and zinc, with an aërated solution of zinc chloride, which has an electro-motive force six times that of the silver-copper cell, and three quarters that of a Daniell's cell. Chloride of zinc is preferable to the sulphate, as it offers less internal resistance, and a solution of 20 per cent. is about the best conductor. A single cell of this kind decomposes dilute sulphuric or hydrochloric acid, with copper electrodes.

The power is thus obtained at a minimum of expense, for the oxygen which combines with the zinc costs nothing.

Such a battery would appear to be specially applicable to cases where the galvanic current has to be frequently broken, as in telegraphy, for, at each period of rest, it renews its strength by the absorption or diffusion of more oxygen from the surrounding air.

SCIENTIFIC SERIALS

Zeitschrift für Ethnologie.—The second number of this journal for 1872 scarcely possesses the same scientific value as former numbers. We have, first, the concluding part of Dr. E. von Martens' lecture, read before the Anthropological Society of Berlin, December 1871, on the different uses of the Conchylia. The paper is characterised by true Germanic exhaustiveness, but it indicates a want of appreciation on the part of the author of the relative value of authorities, ambiguous allusions to Longfellow's "Hiawatha" being adduced as evidence, side by side with the statements of scientific travellers. Dr. Martens passes in review every use to which shells have been put in ancient or modern times, and in civilised or uncivilised countries.—Dr. Robert Hartmann continues his notice of the remains found in the Lake Dwellings of Switzerland, and draws attention to the absence of the domestic cat from the more ancient fauna of Europe. The most numerous animal remains belong to the common European stag (*Cervus elephas*), but are of colossal size, and so nearly akin to *Cervus Canadensis* as to raise the question whether the *C. elephas* of the Swiss Lake deposits may not be identical with *C. canadensis.* No trace of reindeer has been discovered, although that animal was common in Switzerland during the glacial period.

In the third number (1872) of the journal, we have an interesting report of the remains of pile dwellings in the Archipelago of North Celebes, which have been examined by the Dutch "Assistant Resident," J. G. F. Riedel. The paper is illustrated with drawings of these huts, and of the different types of head most commonly observed among the North Celebes tribes in the present day. It would appear that the Aborigines were not lake-dwellers. The Toun Singals, however, who were of foreign origin, and arrived in the country between the 12th and 13th centuries, although they at first dwelt on the strand of the present Negeri Atep, soon left their original settlements, and built themselves pile-huts on the great Minahasa Lake, where they were secure from the pursuit of the robber tribes of Djailolo, whose incessant attacks had been the chief incentive to their immigration. The remains of these lake-dwellings give evidence of their solidity, for Herr Riedal found that the piles were for the most part 3 ft. in diameter, and 20 ft. in height above the surface of the lake; the length of each hut was nearly 70 ft., and the breadth 40 ft. Among other events the enforced conversion to Christianity of the Toun Singals in 1830 has separated them still more from the habits of their race, and the memory of the older pile-dwellings seems to be fast dying out among them.

Dr. Bastian gives us in the third number a very complete and carefully elaborated paper on Comparative Philology. He begins by treating of the physiological formation of speech; and of the widely differing groups of emotions which respectively find expression in vocals and in consonants. He passes in review the various nations, whose original language exhibits a preponderance of either of these distinctive characters. Among the older races of America and Africa consonants largely predominate, while in the Malay Polynesian dialects vocal sounds are strongly in the ascendent. The phonetic character of a language influences its grammatic peculiarities.

Herr Rade, who has spent eight years in endeavouring to discover among the Kaukasian tribes some fixed type of their nation, finds from his prolonged investigation of living and dead skulls that the mingling of races has been so continuous in these regions, that it is impossible any longer to recognise the "Kaukasian Race" as it was defined by Blumenbach. Herr Rade has hitherto failed in detecting certain evidence of the existence of Lacustrine dwellings in any of the Kaukasian lakes which he examined.

Dr. Virchow, at a recent special meeting of the Anthropological Society of Berlin, read an interesting paper on the results of a series of explorations made by himself and his sons in the course of last year in the little island of Wollin, lying off Pomerania, in the Baltic. Wollin or Julin as the locality in which the sea-kings or Vikingar had established their once formidable republican settlement of Jomsburg, has always presented special features of interest for Northern inquirers and historians. The early chroniclers of Northern Germany and Scandinavia make frequent allusion to the enormous wealth and great importance of the trading ports of this small island. After ages of decay and desertion the island is again acquiring some slight amount of recognition through the recent establishment of baths near the little town of Wollin. It is here that Dr. Virchow and his sons found unmistakeable evidences of the early existence of a large and wide-spread population. Near the little lake of Vietzig, under a surface of loam or clay-mud, Dr. Virchow came upon a bed of *débris* from 4 to 7 ft. in depth, which was entirely formed of fish and animal bones, broken vessels, and all the ordinary adjuncts of the Kjokkenmöddinge as they have been revealed in the Lacustrine deposits of Pomerania. At some places where the hills have been cut, the exposed surfaces seem composed almost entirely of the scales and bones of fishes and other animal remains. At one spot, on the S.E. of the present town, a burying ground was discovered, on which 60 grave-hillocks could still be counted. On penetrating below the surface a heap of burnt and fractured bones was found at a depth of 18 to 20 in., but in no grave, explored by Dr. Virchow, was any trace of urn, stones, or textile fragment to be seen; although remains of fused bronze were met with. A small grant of money has been made by the Society for the purpose of continuing the exploration of the island, and if the work should be placed under the direction of Dr. Virchow we may anticipate valuable results from a more systematic investigation of this site of the most formidable piratical republic ever founded in Northern Europe.

In a paper laid before the Societé d'Anthropologie de Paris by M. Broca, on the Toulouse form of narrow or flat-head deformities, the author enters at length into the consideration of the probable effect on the cerebral functions produced by the ligatures, with which the peasant mothers of some parts of south-west France still compress their children's heads.

THE *Zoologist* for April, after a reprint from the *American Naturalist* of Prof. N. S. Shaler's paper, "Notes on the Right and Sperm Whales;" and ornithological notes from Lincolnshire and Devon, enters further into the discussion of Dr. Baldamus' theory as regards the cuckoos' egg. Mr. Hewitson replies sharply to Mr. Smith's paper in the preceding number; Mr. G. D. Rowley opposes the theory, and thinks that "birds are only too glad to sit on cuckoos' eggs," as they will sit on nothing rather than not incubate. Mr. Doubleday writes to the same effect, as does also Prof. Newton in a quotation from the *Field*. Mr. Smith acknowledges that in writing his former letter, he had not seen Prof. Newton's article on the subject in NATURE (vol. iii. Nov. 1869), but still maintains that British ornithologists have not yet investigated the question "in the systematic way, and after the excellent example of painstaking and diligence set us by Dr. Baldamus and Dr. Rey." The editor, referring to a note on the Liberian Hippopotamus which appeared in this periodical a month ago, states that the author has made a mistake in calling it a true hippopotamus. The context clearly shows how the term is meant, and it is an undoubted fact that the English name has a wider meaning than its Latin equivalent. Chœropsis is as true a hippopotamus as Rhinaster or Ceratorhinus are true rhinoceroses, and they are so undoubtedly in the English acceptation of the words, so we think Mr. Newman too ready in discovering errors.

THE *Canadian Naturalist and Quarterly Journal of Science*, vol. vii. No. 1.—The first paper in this number is one which we have already received in a separate form, viz. Principal Dawson's Address as President of the Natural History Society of Montreal. He discusses, (1). The present aspect of inquiries as to the introduction of genera and species in geological time. (2) The growth of our knowledge of the Primordial and Laurentian rocks and their fossils. (3) The questions relating to the so-called glacial period. This is followed by a paper on Some Results of the last Solar Eclipse, in which the author, Mr. G. F. Armstrong, sums up briefly the results which have been obtained from the eclipses of 1865 and succeeding years. In a paper on Cuba Mr. G. F. Matthew makes some contributions to our knowledge of the natural history of that island. There is a geological paper on Huron County, Ontario, and another on the Mineral Region of Lake Ontario. The last paper in the journal is the obituary notice of the late Prof. Sedgwick, which appeared in NATURE.

SOCIETIES AND ACADEMIES

LONDON

Geologists' Association, April 4.—Professor Morris, F.G.S., vice-president, in the chair.—"On the Diamond Fields of South Africa," by Mr. G. C. Cooper.—The theory of an igneous action upon the spot at which the diamonds are now found being the explanation required to solve the problem of their origin was opposed by the author, who adduced facts from his observation in support of the opposite conclusion. He did not consider that the numerous trap dykes which characterise the South African Diamond Fields broke through the present surface, which, on the contrary, had been produced by the accumulation of materials brought by aqueous agency subsequent to the volcanic action which gave rise to the dykes. These materials consisted of a surface layer of red sand overlying a bed, from five to seven feet thick, of fragments of "lime and clay stone;" and beneath this the diamantiferous marl or "stuff" is reached. Steatitic or magnesian matter forms a considerable proportion of the "stuff" which it was contended may have been brought from magnesian rocks at a considerable distance by water and possibly by ice action, and deposited in the hollows formed by the trap dykes, and that these magnesium rocks may have been the original matrix of the diamonds.—"On some Fossils from the Chalk of Margate," by J. W. Wetherell. The author had devoted some time and attention to the exploration of the chalk in the immediate neighbourhood of Margate, and had obtained, as a result, a large number of species of fossils, a list of which was given, with remarks as to relative abundance. In addition to many genera usually abundant in the Upper Chalk, *Belemintella* appears to be well represented in the Margate chalk, and ammonites are also found; but perhaps the most abundant fossil is the *Coscinopora globularis*, which varies in size from that of a walnut to a pin's head. Crystals of selenite were found as well as concretions of iron pyrites, but minerals are by no means common in the chalk of Margate.

Mathematical Society, April 10.—Dr. Hirst, F.R.S., president, in the chair.—Prof. Clifford made a few remarks in correction of a statement he had made at the March meeting during the discussion on Mr. Hayward's paper on an extension of the term *area*.—Mr. J. W. L. Glaisher then proceeded to read a paper on the calculation of the value of the theoretical unit angle to a great number of decimal places.—The following papers (in the absence of the authors) were discussed by Messrs. Clifford, Cotterill, Merrifield, and the president:—On systems of porismatic equations, algebraical and trigonometrical; Note on epicycloids and hypocycloids; Locus of point of concourse of perpendicular tangents to a cardioid; Elliptic motion under acceleration constant in direction; Prof. Wolstenholme, on the theory of a system of electrified conductors; On the focal lines of a refracted pencil, Prof. J. Clerk-Maxwell.

Royal Horticultural Society, March 26.—Special general meeting, Lord Alfred Churchill in the chair.—The business practically consisted in the consideration of two bye-laws proposed by the Council. The first, giving to all the fellows the right of vote by proxy (hitherto restricted to ladies), was rejected. The second, impowering the fellows to elect to vacancies on the Council at a general meeting other than the annual general meeting, if more than half their number resign at any one time, was carried. Great excitement and disorder was manifested throughout the prolonged discussions.

April 2.—General Meeting, Mr. W. Saunders, F.R.S., in the chair.—A communication was read from Mr. Cocks, on budding vines. It was shown (1) that the extirpation of all the buds of the budded plant gave the inserted buds a better chance of success by removing competition, and (2) that there was no advantage in inserting new buds in the seats of those removed.

Scientific Committee, Dr. J. D. Hooker, C.B., F.R.S., in the chair.—Mr. Smee exhibited lemons infested with *Coccus limonii*, which caused the green colour of the unripe fruit to persist round the points of attachment, and injured the lemons for preserving purposes.—The Rev. M. J. Berkeley stated that the new potato disease described by Hallier in his "Parasitenkunde," was no doubt identical with the "copper-web" of the asparagus-growers of the Isle of Ely. It had been described as *Rhizoctonia*.—Dr. Hooker read a portion of a letter from Mr. Woodrow, stating that a succulent composite, *Notonia grandiflora*, had a great reputation as a cure for hydrophobia in the neighbourhood of Bombay.—Prof. Thiselton Dyer pointed out that the seeds of the Sooly Qua were not identical with those of *Luffa acutangula*; they much more resembled those of *Luffa ægyptiaca*.

April 6.—Special general meeting, Lord Alfred Churchill in the chair.—The following new members of Council were elected on the proposition of Lord Strathmore.—Viscount Bury, M.P., Hon. R. Chetwynd, Mr. Hardcastle, M.P., Sir C. Lindsay, Mr. W. A. Lindsay (Secretary), Sir A. Slade, Mr. Hellock, Mr. A. Smee, Mr. H. Little, Mr. R. Warner.

Institution of Civil Engineers, April 8.—Mr. T. Hawksley, president, in the chair. The paper read was "On the Rise and Progress of Steam Locomotion on Common Roads," by Mr. John Head, Assoc. Inst. C.E., and was divided into four parts:—1. Road locomotives for conveyance of passengers, also locomotives for use on tramways. 2. Road locomotives for conveyance of goods, heavy weights, &c., also steam road rollers. 3. Locomotives for use in agricultural operations, steam ploughing, &c. 4. Locomotives for military purposes.

Cambridge Philosophical Society, March 3—Notes on the Hippopotamus, by Mr. J. W. Clark. The author exhibited the mounted skeleton, and some portions of the visceral anatomy, of the female hippopotamus which died in the London Zoological Gardens in January 1872, and made some remarks on the specimens.—"On the Foraminifera and Sponges of the Cambridge Upper Greensand," by Mr. W. J. Sollas. The author described the green grains abundant in the formation, and showed that, like those in many other rocks, they were to a large extent the casts of foraminifera. He then discussed the formation of the so-called coprolites, and showed that in a great number of instances these nodules were phosphatised sponges, just as the flints of the chalk were silicified sponges. He thought that the phosphate of lime might have been derived from the erosion of volcanic rocks in the south of Scotland which had been brought by a current from the north.—"On a Boulder in a coal seam, South Staffordshire," by Mr. Bonney. This boulder, found in the black coal of the Cannock and Rugeley Colliery, a seam nearly 3 yards thick, weighed 13 lbs. 13¾ oz., was about 19 in. in girth either way, and about 4½ in. thick, it was of a compact grey quartzite, apparently identical with one of the rarities in the Bunter conglomerates of the district. He considered that the boulder, which was quite solitary, had been brought to its present position (probably during a flood) entangled in the roots of a tree—and discussed the bearings of its occurrence upon the physical geography of England in the carboniferous and triassic times.

Manchester

Literary and Philosophical Society, April 1.—R. Angus Smith, Ph.D., F.R.S., vice-president, in the chair. "Note on an Observation of a small black spot on the sun's disc," by Joseph Sidebotham, F.R.A.S. On Monday, March 12, 1849, our late member Mr. G. C. Lowe and I saw a small circular black spot cross a portion of the sun's disc. We were trying the mounting and adjustments of a 7 in. reflector we had been making, and used an ink box between the eye-piece and the plane speculum. At first we thought this small black spot was upon the eye-piece, but soon found it was on the sun's disc, and we watched its progress across the disc for nearly half-an-hour. The only note in my diary is the fact of the spot being seen—no time is mentioned, but if I remember rightly, it was about four o'clock in the afternoon.—Mr. Baxendell said in a letter which Mr. Sidebotham had received from Prof. Hamilton L. Smith, of Hobart College, Geneva, New York, the writer suggests the use of iron or bell metal specula, coated with nickel, for reflecting telescopes. He says, "I ground and prepared a bell metal speculum, which I coated with nickel, and this, when polished, proved to be more reflective (at least I thought so) than speculum metal. The two objects which I sought were—first to have a polished surface unattackable by sulphuretted hydrogen (this, for example, is not injured by packing with lucifer matches), and secondly, for large specula, doing most of the work by the turning-tool and lathe. I really think a large, say 3 ft. mirror, coated with nickel, but cast of iron, and finished mostly in the lathe, while it would not cost the tenth of a similar sized speculum metal, would be almost equal to silvered glass of the same size, and vastly more enduring as to polish.—Prof. Williamson, F.R.S., referring to Mr. Binney's remarks at the meeting of March 4, said:—Mr. Binney, after pointing out that I had identified a certain type of stem-structure with *Asterophyllites*, and that Prof. Renault had discovered the same structure in *Sphenophyllum*, Mr. Binney proceeds to say, "I am not in possession of the facts from which the two learned professors came to *such different conclusions*, but I am inclined to consider the singular little stem as belonging to a new genus *until the leaves of Sphenophyllum or Asterophyllites are found attached to it*. When this comes to pass of course there can be no doubt of the matter." I have italicised the two important points in the preceding quotation. In the first place I cannot understand how Mr. Binney has overlooked my statement, made primarily in the Proceedings of the Royal Society, and repeated in the last number of the Proceedings of your meeting of February 4, that I *had* got a number of exquisite examples, showing not only the nodes *but verticils of the linear leaves so characteristic of the plant*." These leaves I have obtained attached to the stems in question in at least a dozen examples. Secondly, Mr. Binney considers that my conclusions and those of my friend Prof. Renault are *different*, whereas they mutually sustain each other in the strongest possible manner. E. W. Binney, F.R.S., said that after having heard Prof. Williamson's remarks his opinion expressed at the meeting of the Society on March 4 last was not altered.

Glasgow

Geological Society, March 27.—Mr. James Thompson, F.G.S., vice-president, in the chair.—Mr. David Robertson, F.G.S., read some further notes on the post-tertiary fossiliferous beds of the West of Scotland. He first alluded to the brick-clays at Jordanhill, about a mile to the north-west of Partrick, and 145 ft. above the present sea-level. The clay here is wrought to a depth of from 12 to 20 ft., in some places rather more. One point of interest in examining the clays of this locality is the position in which the shells of the common mussel (*Mytilus edulis*) are found. This mollusc is commonly thought to have its zone or position near the surface, and to lie above the post-pliocene Arctic shells in the clays of the Clyde district. This no doubt is frequently the case, but it also occurs at greater depths, and overlaid by Arctic shells. Here it is found at a depth of 14 ft., while at a little distance in the same field Arctic shells occur within 6 ft. of the surface. Another feature of interest in the clays of this neighbourhood is the presence of portions of oak trees, some of considerable magnitude. Such pieces of oak, it is well known, are abundant in the peat of every district, but he was not aware of their having been previously found associated with Arctic shells in the clays of any part of the country.—Mr. Robertson then described the cuttings of the Maryhill Gasworks and Stobcross Railway, giving particulars of the beds exposed, especially in the latter, where interesting sections of boulder clay, gravel, sand, and laminated clay have been laid open during the excavations now in progress. The animal remains are sufficient to show the truly marine character of the deposit.—Mr. John Young read a paper on the probable derivation of certain boulders found in the till near Glasgow. He said the great majority of the boulders in the till of the Glasgow district had evidently been derived from tracts that lay to the west and north-west of the city. At the same time it was interesting to note that the ice which had travelled over the district had not proceeded exclusively from western or north-western sources, as the glaciated surface lately discovered at Possil clearly proved. There the rock is striated both from a north-west and a north-east direction; and he showed that the mineral constituents of the till quite corresponded with and confirmed these variations observable in the striæ.

Montreal

Natural History Society, Jan. 27.—During the past summer Mr. J. Richardson, of the Geological Survey of Canada, has made unusually large collections of the fossils, minerals, and other objects of interest from Vancouver and Queen Charlotte. Mr. A. R. C. Selwyn said that these collections establish conclusively the fact that the coal fields of the two islands belong to the same geological horizon. In each case the coal fields are of the same age as the chalk formation of Europe and elsewhere. Further, the coal of Queen Charlotte Island is found to be a true anthracite, and it is the first instance on record of the occurrence of anthracite in formations, as new as the chalk. The coal seams of Vancouver rest directly upon crystalline rocks, in which limestones predominate. Mr. Richardson estimates the Comox coal field, in Vancouver, to have an area of 300 square miles. It is underlaid by coal seams of from 2 to 10 ft. in thickness, which would probably yield an average of 11,840,000 tons per square mile. The total production of this field, to a depth of 1,500 ft. from the surface, is computed to be about 3,552 millions of tons. The Nanaimo coal field has an estimated area of 90 square miles, and contains three or more seams of from 3 to 10 ft. in thickness. Specimens of carvings in wood and stone made by Queen Charlotte Islanders were exhibited. These evince considerable constructive ability, and are almost invariably of a grotesque character.—Mr. Billings gave a description of the distribution of the cretaceous rocks of North America. He then called attention to some of the characteristic fossils of the Vancouver and Queen Charlotte strata, and showed a series of some of the most striking specimens. Among these were large ammonites, nautili, and various marine shells, of the same genera for the most part as those which are frequent in the European chalk formation. He remarked that in the present collection he had not detected any remains of large reptiles, or any sea urchins, both of which are common in the cretaceous rocks of other localities.

Philadelphia

American Philosophical Society, September 20, 1872.—The following papers were read by Prof. E. D. Cope—Third account of Vertebrata from the Bridger Eocene; notices of new extinct Vertebrata from the upper waters of Bitter Creek, Wyoming; from the upper waters of Bitter Creek, Wyoming; "On the existence of *Dinosauria* in the transition beds of Wyoming Territory." In the last it was shown that the coal series of Bitter Creek belonged to the cretaceous formation.—Prof. Houston described a sensitive waterfall in Pike Co., Pennsylvania.—Prof. Chase communicated observations on some new planetary and stellar distances.

October 18.—Two papers from Prof. Cope were read, viz.: "On a new Genus of Vertebrata from the Upper Green River Basin," and descriptions of new extinct reptiles from the same. The former embraced the description of a new genus of *Lemnidæ* or allied group, having the dental formula 2—1—2—3.

November 1.—Prof. Lesley presented a record of authentic data respecting fourteen oil wells in West Pennsylvania.—Prof. Chase presented a paper, "A first approximation to a normal curve of temperature in the northern regions of the continent."—Aubury H. Smith described his observations on the sub-alpine botany of the north shore of Lake Superior, and of its absence in the Lake Nibbegong region farther north, which he had explored in 1872, which he believed was due to the greater coldness of the waters of Lake Superior.—Dr. Leconte gave a hygrometric explanation for the phenomenon, believing similar ones known to him to depend on the difference between dry continental air, and damp winds from sea coasts.

November 15.—Mr. Gabb described the results attained in tabulating Miocene fossils from Santo Domingo. He described 217 extinct and 19 living species, the latter found on both sides of the barrier of Central America, which is capped by Miocene rocks.

December 20.—Prof. Cope read a paper on the zoological regions of the earth, and especially those of North America, agreeing as to the first with Drs. Sclater and Wallace in the main, adopting the Australian, Neotropical, Ethiopian, Neoarctic, and Palæartic (including Palætropical of S. and W.), stating that all the southern continents present marked distinguishing characters. In North America he adopted the Pacific, Lower Californian, Sonoran, Central, Eastern, and Austroriparian, which in the main agreed with those of Baird, the last being the southern part of his eastern, as far north as the isothermal of 773 F. The subdivisions were the Floridan, Louisianian, and Texan; those of the eastern after Allen, Carolinian, Alleghanian, Canadian, and Hudsonian.—Prof. O. C. Marsh gave an account of his discoveries in the Rocky Mountains since 1870, which included the first American *Chiroptera*, *Marsupials*, low forms of *Quadrumana*, birds with biconcave vertebræ, and several species of a new order, *Dinocerata* allied to the *Proboscidia*, but with horns and canine teeth.

January 3.—Prof. P. Fraser read a paper on a hydraulic problem, near Bethlehem Penna.

CALIFORNIA

Academy of Sciences, Dec. 18, 1872. "On the Parasites of the Cetaceans of the N.W. coast of America, with Descriptions of new Forms," by W. H. Dall, U. S. Coast Survey. Among the parasites most widely known as infecting the Cetacea, two classes may be recognised, viz., those which are true parasites, deriving their subsistence from the animal upon which they are found, such as the Pycnogonoids and Cyami, and those which are merely sessile upon the animal, and derive no nourishment or other benefit from it which might not equally well be furnished by an inanimate object, such as the various cirripedes.

VIENNA

I. R. Geological Institute, Jan. 21.—"Fossil Remains of Sirenoidæ found in the Venetian Territory," by Ach. Barone de Zigno. Besides the ribs and other bones of Halitherium which had been discovered many years ago in the upper tertiary beds of the Venetian Alps, the author succeeded in gathering a very rich collection of different species of Sirenoidæ in the lower tertiary beds (with Serpula spirulæa) of the Monte Zuello, near Montecchio, and in the glauconitic limestone of the basin of Belluno. The glauconitic strata of this basin had been taken till now for Eocene; but fossils found therein by Jaramelli—as *Clypeaster placenta* Des., *Scutella*, *Subrotunda* Lam, &c.—prove that they are of Miocene age.—"On the Eruptive Rocks of Styria," by R. von Drasche. The author gives an accurate petrographical analysis of the different eruptive rocks of Southern Styria, which by former observers had been taken for older porphyries, but which M. Stur has proved to be of tertiary age. They are andesites and trachytes. Some of these rocks resemble indeed very much older porphyries, and prove again the difficulty of discerning by mere petrographical or chemical properties eruptive rocks of different geological age.—A. Redlenbacher presented a memoir on the Cephalopods of the Gosau-strata of the Alps. Since the last publications on this matter by Fr. von Hauer, the number of species in our collections has more than doubled. Only eight of them are identical with species out of non-Alpine cretaceous strata, and they belong all to Senonian beds.

Feb. 18.—M. Tschermak gave an accurate description of the slates, quartzites, and limestones, along a section through the so-called Graywacke Zone of the North-eastern Alps, in the vicinity of Reichenau and the Semmering mountain. These rocks had been thought to belong to the Silurian formation, but in the opinion of M. Tschermak part of them were of a still older age. The study of the oldest sedimentary slates and other rocks of the Alps, promises, he thinks, valuable information about the genesis of the crystalline slates.—M. Fr. Foetterle "On the copper and iron ores of Ferriere in the province of Piacenza, in Italy." The valley of the Nure, extending from Piacenza in a south-west direction into the central part of the Appenines, in the upper part of its course is bounded by high mountain ranges, which consist of grey sandstones, alternating with bituminous slates and marls. They belong to the so-called macigno (Vienna and Carpathian sandstone) and are probably of Eocene age. In the highest parts of the valley, in the environs of Boli and Ferriere, the macigno is traversed by numerous masses and dykes of an eruptive rock which is partly gabbro, consisting of large crystals of amphibol and feldspar, and partly serpentine. These eruptive rocks are of a more recent age than the macigno, which is very much altered by contact with them. Partly in the eruptive rocks and partly in the adjacent altered macigno are to be found masses of copper- and iron-pyrites, and of magnetic iron ores; they form boulders of some size, but nowhere regular layers or veins. The mines which have been opened to gain these ores, M. Foetterle thinks, promise no great success.—O. Feistmantel on the relations between the carboniferous and the Permian formations in Bohemia. In some of the Bohemian coal-basins, *e.g.* that of Radowenz at the foot of the Riesengebirge, in the north-western environs of Prague, in the basin of Pilsen, &c., two layers of coal are known, both accompanied by vegetable remains of a pure carboniferous type; but the strata between these layers contain remains of fishes, as Xenacanthus, Acanthodes, Palæoniscus, &c., which belong to the Permian fauna. The author concludes that the upper coal layers of the Bohemian coal-basins belong to the Permian formation, and the lower only to the carboniferous formation, and that both formations are most intimately allied by their identical flora.

DIARY

THURSDAY, April 17.

Linnean Society, at 8.—Burmese *Orchideæ*, from the Rev. C. P. Parish: Prof Reichenbach.—Perigynium of *Carex*: Prof. McNab.
Chemical Society, at 8.—On Heat produced by Chemical Action: Dr. Debus, F.R.S
Numismatic Society, at 7.
Zoological Society, at 4.

SUNDAY, April 20.

Sunday Lecture Society, at 4.—The Theory of Wind Instruments: Dr. W. H. Stone.

MONDAY, April 21.

London Institution, at 4.—Elementary Botany: Prof. Bentley.
Geologists' Association, at 8.—Visit to Museum of Practical Geology.

TUESDAY, April 22.

Royal Institution, at 3.—Music of the Drama: Mr. Dannreuther.
Institution of Civil Engineers, at 8.—Discussion on Mr. Head's paper on Steam Locomotion on Common Roads.—On the Delta of the Danube, and the Provisional Works erected at the Sulina Mouth.—Sir C. A. Hartley.
Anthropological Society, at 8.—Religious Beliefs of Ojibois or Sauteux Indians resident in Manitoba and at Lake Winnepeg: A. P. Reid, M.D.—Danish aspect of the Nomenclature of Cleveland: Rev. J. C. Atkinson.—Rock Inscriptions in Brazil: John Whitfield.

WEDNESDAY, April 23.

London Institution, at 7.—On some Phenomena connected with Magnetism: W. F. Barrett.
Society of Arts, at 8.—On Silk-Worm Grain: M. Alfred Roland.
Archæological Association, at 8.
Society of Antiquaries, at 8.30.—Anniversary.
Royal Society of Literature, at 8.30.—The Serio Comic Satirical Poetry of the 18th and 19th centuries: Sir Patrick de Colquhoun, Q.C., LL.D.
Society of Telegraph Engineers, at 7.30.—On the Block System of Working Railways: W. H. Preece and Capt. Mallock.

THURSDAY, April 24.

Royal Institution, at 3.—Light: Prof. Tyndall.
Royal Society, at 8.30.

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THURSDAY, APRIL 24, 1873

SCIENTIFIC ENDOWMENTS AND BEQUESTS

SOME weeks ago we published the notice issued by Trinity College, Cambridge, respecting a Fellowship offered by that corporation for Natural Science, in which Zoology is one of the subjects by which it may be obtained. Candidates are required to send to the electors "any papers which they may have published containing original observations, or experiments, or discussions of scientific questions, or any similar matter in manuscript," and they "will be liable to be examined in the subjects of their papers and in subjects connected with them, or in the branch of science to which they refer."

A fortnight ago, a New York correspondent gave us the details of a munificent bequest made by Mr. John Anderson, a wealthy merchant of that city, to Prof. Agassiz, and through him to the University of Cambridge, Massachusetts, of Penikese Island, situated about 170 miles east by north of New York, and 12 miles south of Boston, on the New England coast, as a station for the study of Practical Zoology, mainly marine. Finding that pecuniary aid was also absolutely necessary to put the whole in working order, Mr. Anderson, with a liberality almost unprecedented, put 50,000 dollars at Prof. Agassiz's disposal, "as a nucleus for a permanent endowment fund" in the formation of his Marine Naturalists' School.

The above-cited cases are two of the most important steps that have been taken of late to advance the thorough study of zoology either in England or America, but the method employed by the one to arrive at this result is so different from that adopted by the other, that the question may well be asked, which of the two in the long run will produce the most satisfactory results? Is it better, as done by Trinity College, to offer considerable and substantial rewards to students of promise, or, as in the case of Mr. Anderson's gift, to simply place undoubtedly great facilities in the way of untried beginners on the subject?

Notwithstanding the extreme liberality shown by Mr. Anderson in his bequest, we cannot help feeling that most of the previous attempts that have been made to advance science by providing increased facilities for work, without at the same time improving the general prospect of a sufficient livelihood for those who devote the whole or the most of their time to it, have met with but little success; and perhaps there is nothing more disappointing to those who are anxious for the progress of the subject, to see the way in which establishments excellently planned at great cost, are often almost at a standstill for want of their most important element—pupils. Such a method of procedure, if numbers are obtained, is likely but to produce an assemblage of amateur students, whose work, as it must be from the lack of sufficient stimulus to great mental effort, is poor from its want of thoroughness, and therefore comparatively useless in the long run, only encumbering the subject and leading lookers-on to suppose, from the few results arrived at, that the science is not worthy of deeper consideration. Zoology and Biology generally have suffered much already from such kind of work.

The tendency of all observation as to the origin and development of the sciences which are now firmly established, is to prove quite clearly that what was required in each of them to give it a start, and make it continue to advance rapidly, was that it should have a practical bearing of some kind or another. There cannot be the least doubt that the rapid advances which have occurred in the study of electricity, and the large number of valuable discoveries and important laws that have been found out concerning it, are but the expression of the mercantile value of the telegraph system as it now exists; the forensic and manufacturing importance of chemistry has in great measure raised it to the important position it now holds; and the money voted for the observations of the transit of Venus is indirectly connected with the importance of astronomical observation in facilitating navigation. But it is not at all easy to show clearly that there are any direct practical results to be arrived at from the study of zoology; the knowledge of the facts that our relationship with the higher apes is more intimate than has been till lately supposed, and that we must consider an Ascidian as the Noah of our zoological pedigree, may be of interest to many as curious results, but they do not lead to or suggest fresh methods of action on the part of anyone, and cannot otherwise be made profitable. Consequently other means must be employed to cause the science to progress in a manner which does credit to the large number of new facts which are continually being brought forward, and the method adopted by Trinity College is one which promises the best results. That the prospect of a Fellowship is a strong inducement to work is undisputed, and what all biologists would like to see, is a little more willingness on the part of other colleges in both Universities, to give them to deserving students of the subject. Some profess to place natural science on the same footing as the other University final examinations, with regard to pecuniary rewards, but it is very seldom, scarcely ever indeed, that we have the opportunity of recording in our columns any elections to natural science fellowships. As long as classics hold the position that they do—one maintained only by the funds and appointments which, but from an excessive and short-sighted conservatism, would have been in great measure diffused in other directions long before now, no complaint can be made of the comparatively non-practical bearing of zoology and comparative anatomy; for though classics may be a good mental training, so is the latter, and the study of the former has certainly not a more practical bearing.

The principle on which the election to the New Trinity Fellowship is to be conducted, is evidently the result of mature consideration and experience, partly no doubt arrived at after the unsuccessful experiment in the same direction a little more than two years ago, in which it was made too evident that a simple examination on the subject could not ensure the discovery of a genuine Zoologist. A much more successful result may be anticipated from the new system of election, for it is difficult to believe that any candidate, who at the time of election has completed sufficient good work to satisfy the electors, can possibly, on account of its intrinsic interest when he has arrived so far, give up the further pursuit of scientific work. When the governors of any institution can bring men up to this point, and can then supply them with the necessary means, they may consider that their work is finished.

CLERK-MAXWELL'S ELECTRICITY AND MAGNETISM

A Treatise on Electricity and Magnetism. By James Clerk-Maxwell, M.A., F.R.S., Professor of Experimental Physics in the University of Cambridge. (Clarendon Press Series, Macmillan & Co., 1873.)

IN his deservedly celebrated treatise on "Sound," the late Sir John Herschel felt himself justified in saying, "It is vain to conceal the melancholy truth. We are fast dropping behind. In Mathematics we have long since drawn the rein and given over a hopeless race." Thanks to Herschel himself, and others, the reproach, if perhaps *then* just, did not long remain so. Even in pure mathematics, a subject which till lately has not been much attended to in Britain, except by a few scattered specialists, we stand at this moment at the very least on a par with the *élite* of the enormously disproportionate remainder of the world. The discoveries of Boole and Hamilton, of Cayley and Sylvester, extend into limitless regions of abstract thought, of which they are as yet the sole explorers. In applied mathematics no living men stand higher than Adams, Stokes, and W. Thomson. Any one of these names alone would assure our position in the face of the world as regards triumphs already won in the grandest struggles of the human intellect. But the men of the next generation—the successors of these long-proved knights—are beginning to win their spurs, and among them there is none of greater promise than Clerk-Maxwell. He has already, as the first holder of the new chair of Experimental Science in Cambridge, given the post a name which requires only the stamp of antiquity to raise it almost to the level of that of Newton. And among the numerous services he has done to science, even taking account of his exceedingly remarkable treatise on "Heat," the present volumes must be regarded as pre-eminent.

We meet with three sharply-defined classes of writers on scientific subjects (and the classification extends to all such subjects, whether mathematical or not). There are, of course, various less-defined classes, occupying intermediate positions.

First, and most easily disposed of, are the men of calm, serene, Olympian self-consciousness of power, those upon whom argument produces no effect, and whose grandeur cannot stoop to the degradation of experiment! These are the *à priori* reasoners, the metaphysicians, and the *Paradoxers* of De Morgan.

Then there is the large class, of comparatively modern growth, with a certain amount of knowledge and ability, diluted copiously with self-esteem—haunted, however, by a dim consciousness that they are only popularly famous—and consequently straining every nerve to keep themselves in the focus of the public gaze. These, also, are usually, men of "paper" science, kid-gloved and black-coated—with no speck but of ink.

Finally, the man of real power, though (to all seeming) perfectly unconscious of it—who goes straight to his mark with irresistible force, but neither fuss nor hurry—reminding one of some gigantic but noiseless "crocodile," or punching engine, rather than of a mere human being.

The treatise we have undertaken to review shows us, from the very first pages, that it is the work of a typical specimen of the third of these classes. Nothing is asserted without the reasons for its reception as truth being fully supplied—there is no parade of the immense value of even the really great steps the author has made—no attempt at sensational writing when a difficulty has to be met; when necessary, there is a plain confession of ignorance without the too common accompaniment of a sickening mock-modesty. We could easily point to whole treatises (some of them in many volumes) still accepted as standard works, in which there is not (throughout) a tithe of the originality or exhaustiveness to be found in any one of Maxwell's chapters.

The main object of the work, besides teaching the experimental facts of electricity and magnetism, is everywhere clearly indicated—it is simply to upset completely the notion of *action at a distance.* Everyone knows, or at least ought to know, that Newton considered that no one who was capable of reasoning at all on physical subjects could admit such an absurdity: and that he very vigorously expressed this opinion. The same negation appears prominently as the guiding consideration in the whole of Faraday's splendid electrical researches, to which Maxwell throughout his work expresses his great obligations. The ordinary form of statement of Newton's law of gravitation seems directly to imply this action at a distance; and thus it was natural that Coulomb, in stating his experimental results as to the laws of electric and magnetic action which he discovered, as well as Ampère in describing those of his electro-dynamic action, should state them in a form as nearly as possible analogous to that commonly employed for gravitation.

The researches of Poisson, Gauss, &c., contributed to strengthen the tendency to such modes of representing the phenomena; and this tendency may be said to have culminated with the exceedingly remarkable theory of electric action proposed by Weber.

All these very splendid investigations were, however, rapidly leading philosophers away towards what we cannot possibly admit to be even a bare representation of the truth. It is mainly to Faraday and W. Thomson that we owe our recall to more physically sound, and mathematically more complex, at least, if not more beautiful, representations. The analogy pointed out by Thomson between a stationary distribution of temperature in a conducting solid, and a statical distribution of electric potential in a non-conductor, showed at once how results absolutely identical in law and in numerical relations, could be deduced alike from the assumed distance-action of electric particles, and from the contact-passage of heat from element to element of the same conductor.

But we must give Maxwell's own frank and ample acknowledgment of his debt to these two men.

"The general complexion of the treatise differs considerably from that of several excellent electrical works, published, most of them, in Germany, and it may appear that scant justice is done to the speculations of several eminent electricians and mathematicians. One reason of this is that before I began the study of electricity I resolved to read no mathematics on the subject till I had first read through Faraday's 'Experimental Researches on Electricity.' I was aware that there was supposed to be a difference between Faraday's way of conceiving phenomena and that of the mathematicians, so that neither he nor they were satisfied with each other's language. I had also the conviction that this discrepancy did not arise from either party being wrong. I was first convinced of this by Sir William Thomson, to whose advice and assistance, as well as to his published papers, I owe most of what I have learned on the subject.

"As I proceeded with the study of Faraday, I perceived that his method of conceiving the phenomena was also a mathematical one, though not exhibited in the conventional form of mathematical symbols. I also found that these methods were capable of being expressed in the ordinary mathematical forms, and thus compared with those of the professed mathematicians.

"For instance, Faraday, in his mind's eye, saw lines of force traversing all space where the mathematicians saw centres of force attracting at a distance: Faraday saw a medium where they saw nothing but distance: Faraday sought the seat of the phenomena in real actions going on in the medium, they were satisfied that they had found it in a power of action at a distance impressed on the electric fluids."

It certainly appears, at least at first sight, and in comparison with the excessively simple distance action, a very formidable problem indeed to investigate the laws of the propagation of electric or magnetic disturbance in a medium. And Maxwell did not soon, or easily, arrive at the solution he now gives us. It is well-nigh twenty years since he first gave to the Cambridge Philosophical Society his paper on *Faraday's Lines of Force*, in which he used (instead of Thomson's heat-analogy) the analogy of an imaginary incompressible liquid, without either inertia or internal friction, subject, however, to friction against space, and to creation and annihilation at certain sources and sinks. The velocity-potential in such an imaginary fluid is subject to exactly the same conditions as the temperature in a conducting solid, or the potential in space outside an electrified system. In fact the so-called equation of continuity coincides in form with what is usually called Laplace's equation. In this paper Maxwell gave, we believe for the first time, the mathematical expression of Faraday's *Electro-tonic* state, and greatly simplified the solution of many important electrical problems. Since that time he has been gradually developing a still firmer hold of the subject, and he now gives us, in a carefully methodised form, the results of his long-continued study.

A sentence like the following has a most cheering effect when we meet with it in a preface; and we need only add that our author has been thoroughly successful in the endeavour he promised :—

"I shall avoid, as much as I can, those questions which, though they have elicited the skill of mathematicians, have not enlarged our knowledge of science."

He might with truth, and with propriety, have added that he would also avoid, as far as possible, those so-called experimental illustrations which require in the operator training akin to that of a juggler, and which are calculated to mystify, and to retard the progress of, the real student, while gratifying none but the mere gaping sight-seer.

It is quite impossible in such a brief notice as this to enumerate more than a very few of the many grand and valuable additions to our knowledge which these volumes contain. Their author has, as it were, flown at everything ;—and, with immense spread of wing and power of beak, he has hunted down his victims in all quarters, and from each has extracted something new and invigorating —for the intellectual nourishment of us, his readers.

The following points, however, appear to us to be especially (we had almost said exceptionally) worthy of notice :—

1. Though not employing the Quaternion *Calculus*, Maxwell recognises its exceeding usefulness in exhibiting (merely by the extraordinary simplicity and comprehensiveness of its notation) the mutual relations of various directed, or vector, quantities ; together with their derivation from scalar quantities, such as potentials, by the use of the Hamiltonian ∇, the operator whose square is the negative of the scalar operator in Laplace's equation. There can be little doubt that in this direction must lie the next grand simplification of the somewhat complex mathematics of electro-dynamic investigations.

2. The notion of electric *Inertia*, first clearly pointed out by Helmholtz and Thomson, is here developed in a most splendid style. The mechanism whose inertia has to be overcome before a steady current of electricity can be started or stopped in a conductor, and which opposes a resistance exactly analogous to the inertia equivalent of an ordinary train of wheels, is treated by means of the general equations of motion in the forms given respectively by Lagrange and by Hamilton. Maxwell has adopted from Thomson and Tait's "Natural Philosophy" the idea of commencing with the impulse required to produce a given motion of a system, and has developed in this way the general equations in a form suitable for electric problems where the mechanism is as yet entirely unknown.

3. The chapter dealing with *Electrolysis* we may specially refer to, as containing, not merely an admirable summary of what was previously known but also, several new ideas apparently of great value.

4. Another curious feature of the work is the amount of labour bestowed upon the exceedingly useful, but dry and uninteresting, pursuit of accuracy in the tracing of the forms of *Lines of Force* and determinations of strengths of electric and electro-magnetic fields, and their deviation from uniformity under various conditions, some of excessive complexity. For the theory of the newer instruments, especially Thomson's electrometers and galvanometers, and also for their applicability to problems in quite different branches of physics, these results are very valuable.

5. Another feature in which this differs from all but a very few of the very best scientific works is the particular care bestowed upon the modes of measurement, the units employed, and the *Dimensions* (in terms of these units) of the various quantities treated of—such as, for instance, Electric Quantity, Electric Potential, Electric Current, Electric Displacement, &c.

6. The subject of *Electric Images* is developed at considerable length, and the reader is led up by easy steps to a sketch of the grand problem which, though solved in simple finite terms a quarter of a century ago by Thomson, has remained unnoticed till very recently, viz., the statical distribution of electricity upon a spherical bowl.

7. The subject of *Spherical Harmonics* (Laplace's coefficients) is also treated at some length, and in a somewhat novel way, which leads to one of the quaternion methods of attack though without actually employing that calculus itself.

8. Further, there is given, for the first time, the complete solution of the problem of *Induction of Currents* in a disc rotating in the magnetic field, taking account of the mutual action of the currents on one another—a condition which very materially increases the difficulty of the problem. The result is a very curious one; and it appears especially curious when we compare the very simple, almost homely, methods employed by Maxwell with the elaborate analysis by means of which Jochmann and others, some years ago, attacked the incomplete and (comparatively) easy statement of the problem where the mutual action of the currents is not taken account of. This piece of work is worthy of being placed beside that of Thomson, referred to under (6) above, as among the very best things ever done in Mathematical Physics.

9. The ratio of the electro-magnetic to the electrostatic unit of electricity is a *Velocity* whose absolute value is independent of the magnitude of the fundamental units employed. This has been shown by Maxwell to be the velocity with which waves of transverse vibration will be propagated in the medium whose stresses &c. account on his theory for the apparent action at a distance. Neither the velocity of light in free space, nor the ratio of the electric units, is *certainly* known as yet within five or six per cent., but it is assuredly a most striking fact that (in millions of metres per second) three of the best determinations of the former of these quantities give

314, 308, 298,

while apparently equally good determinations of the latter give

311, 288, 282.

Such approximation is evidently much more than a mere fortuitous coincidence, it shows that a great step has been taken in the grand question of the connection between radiation and electrical phenomena.

Having said so much in hearty admiration of this noble work, a work which will do more to raise our country in the eyes of really competent judges than cartloads of more pretentious publications, it is only natural to seek some of its defects. There are spots on every sun; and they are, as phenomena, sometimes more instructive and therefore more worthy of observation than the sun itself. But, as they are not visible save to those whose eyes can bear the full glare of the glowing orb, and who therefore do not require our aid, it is unnecessary to point them out. Such a proceeding would be mere pandering to that miserable form of envy which leads inferior minds to gloat over the defects of their superiors.

The concluding section of the work is particularly well fitted to terminate our article.

"We have seen that the mathematical expressions for electrodynamic action led, in the mind of Gauss, to the conviction that a theory of the propagation of electric action in time would be found to be the very keystone of electrodynamics. Now we are unable to conceive of propagation in time, except either as the flight of a material substance through space, or as the propagation of a condition of motion or stress in a medium already existing in space. In the theory of Neumann, the mathematical conception called Potential, which we are unable to conceive as a material substance, is supposed to be projected from one particle to another, in a manner which is quite independent of a medium, and which, as Neumann has himself pointed out, is extremely different from that of the propagation of light. In the theories of Riemann and Betti it would appear that the action is supposed to be propagated in a manner somewhat more similar to that of light.

"But in all of these theories the question naturally occurs:—If something is transmitted from one particle to another at a distance, what is its condition after it has left the one particle and before it has reached the other? If this something is the potential energy of the two particles, as in Neumann's theory, how are we to conceive this energy as existing in a point of space, coinciding neither with the one particle nor with the other? In fact, whenever energy is transmitted from one body to another in time, there must be a medium or substance in which the energy exists after it leaves one body and before it reaches the other, for energy, as Torricelli* remarked, 'is a quintessence of so subtle a nature that it cannot be contained in any vessel except the inmost substance of material things.' Hence all these theories lead to the conception of a medium in which the propagation takes place, and if we admit this medium as an hypothesis, I think it ought to occupy a prominent place in our investigations, and that we ought to endeavour to construct a mental representation of all the details of action, and this has been my constant aim in this treatise."

OUR BOOK SHELF

Medizinische Jahrbücher Herausgegeben, Von der K. K. Gesellschaft der Aerzte redigert von S. Stricker. Jahrgang 1872. Hefte i. ii. iii. iv., pp. 513; mit xii. Tafeln.

THE second volume of Stricker's *Medizinische Jahrbücher*, now before us, maintains the promise of the first. It is made up of a number of separate essays on various subjects, physiological, pathological, and medical; the physiological essays predominating over the others.

Amongst these the following deserve notice.

1. Researches on the heart and blood-vessels, by Dr. Sigismund Mayer. In this paper Dr. Mayer shows that the extraordinary increase of pressure of the blood against the walls of the blood-vessels which occurs as a result of the administration of strychnia is due to intense excitation of the vaso-motor centre in the brain, which leads to contraction of the small arteries.

2. A paper by Ewald Hering on the influence of the respiration upon the circulation. In this he shows that moderate expansion of the lungs by insufflation causes diminished blood pressure in the arteries and increased rapidity of the heart's action. This latter effect, however, is not due to the increased pressure exerted upon the external surface of the heart, nor to alterations in the conditions of resistance in the circulation; nor to differences in the exchange of gases; nor to any dislocation of the heart's position, but is effected reflectorially through the pneumogastrics in such a manner that the activity of the cerebral centre of the inhibitory nerves is lowered.

3. MM. Oser and Schlesinger give the details, in an elaborate essay, of many experiments they have made to determine the causation of the movements of the uterus, and state that they have arrived at the conclusion that these movements can be induced by suspension of the respiration; by rapid loss of blood; or by arrest of the supply of arterial blood to the brain.

4. M. M. Rosenthal contributes an interesting essay on the death of the muscles of the body, and on apparent death. He made many experiments on about twenty sub-

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* *Lezioni Accademiche* (Firenze, 1715), p. 25.

jects on the time after death, or rather after the last respiration to show that contraction of the muscles could still be induced by electricity, when applied to them either in the form of the interrupted or of the continuous current. The excitability of the muscles appears to be the same as before death, for a short time after death has taken place; then contractility departing rather sooner in chronic disease than in cases where death has been occasioned by an accident or other sudden event. In most cases contractions may be excited for from 1½ hour to 3 hours after death. The reaction to induced currents falls in a centrifugal direction; the sphincter palpebrarum retaining its irritability longest. From these experiments he was led to think that the absence of irritability in the muscles might be taken as a good means of distinguishing between real and apparent death, and accidentally very shortly afterwards a case of apparent death in an hysterical patient permitted him to satisfy himself as well as others of its value.

5. C. Heitzmann gives the results of his researches on healthy and inflamed bone, and agrees with Rokitansky, that blood is formed in the mother shells that under certain conditions appear in bone.

Other physiological papers are, one by Prof. Bizzozero, of Pavia, on the so-called endogenous formation of cells. Another by Dr. Kolisko, on the mechanics of the heart, and another by Schiff on the round ligament. The papers dealing with therapeutics, are (1) an essay by Dr. Basch on the action of nicotin, especially bearing on the question of the relation of the blood pressure to the periods of rest and contraction of the muscular tissue of the intestines; (2) a number of minor communications from Schroff containing the results of investigations made in the Vienna Pharmacological Institution. The pathological papers of most importance are (1) the remarkable essay of Lostorfer which has led to so much discussion in Germany, in which he declared that he was able to diagnose a certain specific disease (syphilis), by a microscopic examination of the blood; (2) an account by Dr. Philipp Knoll of a case of the rare disease termed paralysis pseudo-hypertrophica; (3) an essay by Dr. J. Popoff on pneumomycosis; (4) investigations on the organisation of thrombus by Dr. Durante; (5) on the changes taking place in ligatured vessels by Dr. Dudokaloff; (6) the diagnosis of disease of the optic thalami. Besides these are several others. The plates are very fairly executed, and our readers will see that Prof. Stricker has done good service in publishing these papers and essays in a collected form. H. P.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Reflected and Transmitted Light

[The following correspondence has been sent us by Prof. Tyndall]:—

Cliff House, Greenhithe, April 8

A CURIOUS thing in connection with colour having come under my notice, and never having before seen it remarked in any scientific journal, I take the liberty of bringing it before your notice; if it is new to you it will interest you, if not I must ask you to excuse me for troubling you. On looking through a piece of blue glass (of which I forward you a sample) at a plant or tree lit up by the sun, those leaves that are lit from behind, or rather by transmitted light, appear of a rich crimson, the other leaves, seen only by reflected light, merely take the colour given by the glass. In the case of a geranium plant, those leaves become almost the same colour as the flowers. As a scientific fact, if new, it is curious.

To Prof. Tyndall WALTER B. WOODBURY

THE observation you describe is interesting, and if you have taken care to exclude subjective colouring, is, I should think, to be explained in this way.

The light from your leaves contains a quantity of red: it appears as a yellowish green, I suppose, and contains little or no blue.

Your glass is of a kind which transmits the two ends of the spectrum while cutting out its centre. It is very hostile to the yellow, hence, on placing it before the eye, and receiving through it light which has already been deprived of its blue, the glass quenches the yellow, and red alone remains.

April 9 JOHN TYNDALL

I detained this note until the arrival of sunshine, which enables me to say that the explanation here given is correct. Employing a blue medium, which does not transmit red you get no effect of the kind you describe. The tender leaves of spring are best suited for the experiment: the hard green leaves of ivy, for example, do not produce the effect.

It is not necessary, nor indeed desirable, to have the leaves between the eye and the sun.

April 15

The Zoological Collections in the India House

PERMIT me to offer my testimony in general support of the view taken by P. L. S., in the able article which appeared in your last number. Rather more than a year ago it was a matter of importance for me to examine the type of Horsfield's *Turdus varius*, contained in the Museum of the Old East India Company. I applied in the proper quarter for leave to examine the specimen, but received a polite answer informing me that it was inaccessible. The official statement therefore said to have been made in the House of Commons on March 14, 1871, by the Under-Secretary of State for India, as to the collections being still "available to men of science" is untrue, and I trust that some member of Parliament will not allow this subject to be lost sight of, but, by continually recurring to it, compel the Administration to open their valuable Museum to the public—its owners. To the two solutions of the difficulty suggested by P. L. S., allow me to add a third. If neither the authorities at South Kensington nor in Great Russell Street can properly exhibit the East India Museum, let it be transferred (of course under suitable guarantee), to some other National Institution.

Cambridge, April 22 ALFRED NEWTON

On the Affinities of Dinoceras and its Allies

IN the April number of the *American Journal of Science and Art* there is a paper by Prof. O. C. Marsh, entitled "Additional Observations on Dinocerata," in which we learn that Dinoceras has only four toes. The author still continues to consider the genera *Dinoceras* and *Tinoceras* a separate order intermediate between the Proboscidia and the Perissodactylata. The facts at my disposal are now sufficient for me to state with considerable certainty that *Dinoceras* and *Tinoceras* are members of the Ungulata Artiodactylata. The following are my reasons:—

1. The palate is complete between the posterior molars, as is seen clearly in a photograph of *Tinoceras grandis* (*Loxolophodon cornutus* Cope) in my possession.
2. There is no third trochanter to the femur (Marsh).
3. The astragalus has a well-marked cuboid facet (Marsh).
4. The posterior molar has a small but well-developed third cusp, as proved conclusively by an inspection of my photograph.
5. The anterior premolar is wanting, six only being present.
6. The premaxillæ are edentulous.
7. There are four toes, an even number.

A. H. GARROD

11, Harley Street, April 22

Auroral Display

A SHORT but very brilliant display of aurora was visible here this evening, making its first appearance soon after sunset, and reaching its greatest intensity between nine and ten o'clock. Some notes of its phases which I was able to make in a perfectly clear sky will perhaps afford useful comparisons with descriptions furnished by observers of its appearance at other places.

The sun had set behind cirrus clouds, surrounded by a slight halo, and with a faint mock-sun on its northern side. As darkness approached, the hazy clouds in the north-west were surmounted by a faint light, and at half-past eight o'clock luminous streaks here and there across the otherwise clear sky, apparently of cirrostratus cloud, had considerable resemblance to auroral beams faintly visible in the twilight; a considerable extension of the twilight-glow towards the north-west also suggested the very possible character of their light. Towards nine o'clock Mars rose redly through a considerable haze in the east, and Venus, in full splendour, appeared setting among slight clouds in the west; the planet Jupiter, and all stars above a slight distance from the horizon, were altogether unobscured by clouds. A pretty bright white auroral arch, divided into low streamers, was at this time first distinctly formed, its lower edge being well marked by their bases, and the brightest streamers being clustered in two knots of the arch, in the middle of Cassiopeia, and of Lyra, the first immediately under Polaris, and the other close to the north-east horizon; the western prolongation of the arch was faint and diffuse, shining from behind and among the clouds around the planet Venus. Tall but faint streamers rose from it, none of which were conspicuous, excepting a pretty well defined one rising at $9^{h}\ 5^{m}$ from the strongly luminous light-cloud in Lyra, nearly to the tail-stars of Ursa Major. This beam grew sharper, and in the following minute it passed across σ Herculis, and ε Ursæ Majoris, but it shortly disappeared. Between $9^{h}\ 8^{m}$ and $9^{h}\ 12^{m}$ the two principal light-clouds in Cassiopeia and Lyra increased in strength, assuming with the contiguous part of the arch a perfect resemblance to the heavy fringe of a curtain gathered or folded upon itself at those points, and particularly in the group of streamers under α Lyræ. At $9^{h}\ 12^{m}$ another luminous patch marked the western end of the arch between Venus and Capella, growing brighter, and from it a bunch of rose-coloured streamers sprang upwards between Auriga and Gemini as far as the forefoot of Ursa Major. At $9^{h}\ 15^{m}$, the bright cloud-mass marking the eastern horizon-point of the arch under α Lyræ also acquired great strength, throwing up a torch-like, fire-coloured streamer of moderate height and great brightness, terminating the arch abruptly in that direction. It rose from the horizon across ο, χ to π, ρ, Herculis. A fainter arch underneath the former one was visible at this time, but less well-defined, and streamers rising from both arches, and mingling together, soon quite overspread the northern sky; a bunch of these streamers of rich crimson colour appeared at $9^{h}\ 18^{m}$, extending for a short time across ο, θ, and other neighbouring stars of Ursa Major, and fading gradually away, disappeared almost as quickly as it came. The number and sharpness as well as the height of the streamers rising from both the arches were now very great, and the light from all the surrounding streamers was so strong that I could read my watch and correct notes in my note-book at this time. A fourth bunch of red streamers rose from the arch at its extreme west end at $9^{h}\ 23^{m}$ from the neighbourhood of α Orionis to the stars γ, ν, in the feet of Gemini. This was the last strikingly red streamer seen during the display; its spectrum, like that of the white beams, which I examined with a small pocket spectroscope, appeared to consist only of the usual bright greenish line, which was very vivid in every phase of the aurora.

At $9^{h}\ 25^{m}$, the whole northern half of the sky was covered with streamers, and arches, gradually forming a corona overhead, and increasing rapidly to great intensity and brightness. The boundary of the light from east to west was a definite line passing through, or very little south of the corona, whose centre was 3° or 4° east from the stars ν, χ in Ursa Major. Northwards from the boundary line the aurora consisted of six or seven parallel arches (of which only the lowest two had before been visible), more or less distinctly succeeding each other between the zenith and the horizon. Both the arches and streamers were stationary, and presented no sensible tendency to motion, however slow, while they were visible. At this time the brightening streamers began to flicker in their light. Waves of light, rising from the north, succeeded each other rapidly, and appeared to flow swiftly over them towards the zenith. Arch after arch was visible as the waves passed over them, and fitful gleams among the auroral masses overhead shot to and fro there, like flashes of summer lightning. The rays and wisps of the corona, and belts, or fragments of the aurora overhead were rendered especially luminous by these discharges. Farther from the zenith, in the north, the waves rose smoothly and steadily, with a motion that was indeed very swift, but it was yet quite distinctly discernible, and more easily distinguishable there, than in their passage overhead. The arches, or belts of the streamers appeared to be lighted up instantaneously, as they were reached. Although their inter-mixture in the north made it very difficult to decide this clearly, yet the upward progress of the waves there was very evident, while no such ascending movements could be distinguished in the east and west quarters of the sky. The belts and arches stretching towards those parts of the horizon, through the zenith, and past, or through the corona, forming the termination of the aurora towards the south, were constantly lighted up by momentary flashes, extending almost simultaneously along their whole lengths. The brightness of the flashes in those parts of the aurora which included the corona, and arches or lateral branches extending from it towards the magnetic east and west points is easily accounted for by the belts and clusters of streamers in those positions being seen "on edge," or "end on," extremely foreshortened by perspective, so that the increase of light along their whole heights appeared to be concentrated, when the waves overtook them, to a single flash. The motion of the waves must be extremely swift, as they scarcely occupied more than a second in passing from an altitude of about 45° to the zenith. Supposing that (as the best observations of them have frequently agreed in showing) the heights of auroral arches, and of the bases of auroral streamers, are usually about 100 miles above the earth's surface, the velocity of propagation of these waves of electrical disturbance from north to south cannot have been much less than 100 miles per second. Such a prodigious velocity cannot possibly be ascribed to waves in the upper atmosphere driven by winds among its rarified strata, to which the sweeping motion of the light waves apparently wafted by gusts among the streamers otherwise bore a very singular resemblance.

At $9^{h}\ 34^{m}$ some of the strongest waves passing across the corona lighted up a faint white arch in the south, extending from Arcturus across the northern part of Virgo to the head of Leo, several degrees in width. At $9^{h}\ 37^{m}$, when the wave disturbance, after continuing in full activity for about ten minutes, ceased as rapidly as it began, this arch and the corona still remained faintly visible; but together with all the other arches and streamers of any altitude lately lighted up by the waves, they soon vanished, and the whole appearance of the sky at $9^{h}\ 40^{m}$ was about the same as when the aurora was first seen. At $9^{h}\ 43^{m}$, however, the northern sky was again crowded in every part with thin white streamers scattered indiscriminately over it, like groves of slender fir-trees on a hill-side, among which one very sharp and bright ray shone for a few seconds, springing from the horizon to a considerable altitude in the west, where it passed across ζ Tauri. At $9^{h}\ 50^{m}$ a streamer, starting from a base of intense whiteness near the same place, and tinged at the top with a pinkish hue, ascended across the stars μ, ν, as far as the star ι in Gemini, another very similar streamer almost simultaneous with it, also extended from between Gemini and Auriga to near the forefoot of Ursa Major; a few spots of very intense white light were at the same time visible here and there among the low clouds near the north-west horizon. At $9^{h}\ 55^{m}$ all conspicuous streamers had disappeared, leaving only a general glow, among the brighter parts of which the wave disturbance began again, and with less intensity than before, but with the same regularly ascending motions; the undulations succeeded each other without intermission until $10^{h}\ 5^{m}$; they then ceased, and the faint appearances of the aurora which were visible after this time were, so far as I could observe them, until half-past eleven o'clock, of a very insignificant and inconspicuous character. The times in this description are from a comparison of my watch with the clock in the Carlisle railway station, and its hand and the figures on its dial being always distinctly visible by the light of the aurora, they have probably been recorded rightly to the nearest minute. Although the dates of the April meteoric shower usually occurring on the nights of the 19th—21st of April are near at hand, I saw but one small shooting-star during the hour of the auroral exhibition. It had a short course in one of the brightest parts of an auroral cloud, and in its light and the aspect of its nucleus it did not appear to be affected in any way remarkably by its passage near or underneath the beams of the aurora.

A. S. HERSCHEL

Carlisle, April 18

April Meteors

DURING the evenings of April 19 (9^{h} to 11^{h}) and 20th ($8^{h}\ 45^{m}$ to $11^{h}\ 15^{m}$) 20 shooting stars were observed here. The sky was cloudless on both nights, and on the 18th and 19th bright displays of auroræ were noticed. Of the 20 meteors 12 were well observed, and their tracks accurately marked; 8 of these radiated from near α Lyræ, or from a point at R. A. 274°, D. 37+. The following are the details:—

Date.	Time.		Beginning.		Ending.	
			R. A.	D.	R. A.	D.
April 19	9.28	1st mag. ✱	295°½	46°+	316°	51°+
,,	10.31	2nd mag. ✱	305	38 +	309	37½+
,,	10.43	3rd mag. ✱	277	36½+	278½	35 +
,,	10 50	4th mag. ✱	256½	17 +	254	13 +
April 20	9 10	3rd mag. ✱	266	17 +	264½	13 +
,,	9 50	3rd mag. ✱	319	45 +	329	45 +
,,	11.4	2nd mag. ✱	282	22 +	285	16 +
,,	11.13	2nd mag. ✱	264½	16 +	261½	9 +

The other four showed a well-marked radiant point at R. A. 231°½, D. 20 + in Bootes. The observed paths of these were as under:—

Date.	Time.		Beginning.		Ending.	
			R. A.	D.	R. A.	D.
April 19	9.58	2nd mag. ✱	307°½	43°+	285°	33°+
April 20	9.9	3rd mag. ✱	247	28 +	258	29 +
,,	9.54	1½ mag. ✱	244	53 +	268	67 +
,,	10.55	1st mag. ✱	225	19 +	246	16 +

The brightest meteor seen was one that appeared at 9^h 28^m on April 20. It diverged from the radiant in Lyra, and was about equal in brilliancy to α in that constellation. This meteor left a train which remained visible about 1½ sec. after the disappearance of the head.

Bristol, April 21 WILLIAM F. DENNING

I SEND the following observations of the shooting stars of the April period, viz., the 19th and 20th. On the 19th I began to watch at 10^h, but saw no more until 11 45. I then watched them until 3^h 15^m. I found they seemed to come in the region of the heavens about Corona, so I confined my observations to that part as I had not a situation where I could see the opposite side as well By 10 o'clock Hercules was quite above the buildings, so there may have been some meteors visible earlier, when these constellations were too low for me to see. The first night they were all comprised in a triangle, which would be formed by a line stretching from Vega by way of Ophiuchus to Mars, and thence up to Arcturus and by Corona back to Vega. They were pretty equally distributed over this region. The next night they were much more concentrated in Ophiuchus and Hercules and towards Libra. I was not able to determine the radiant, so I confined myself to reckoning them accurately in intervals of fifteen minutes, which time I had conveniently marked for me by the church clocks, and only observed their tracks approximately. On the second night I noted the position and direction of each which shows their concentration about the part named. On the nineteenth there were 25—15 horizontal, 10 vertical. On the 20th from 9.45 to 2.45 there were 33—22 vertical and 11 horizontal. Those I call vertical by distinction were almost all just half way between horizontal and vertical, *i.e.* at an angle of 45°. It was curious how this angle predominated. It was also curious that the first night the horizontal ones predominated, and the second night the vertical. I do not know if I am wrong (1) in assuming that we pass through the node of the orbit of the meteors at this time, and (2) in inferring from this assumption that the angle at which they principally appear to us would be a guide to the inclination of the node. Would the fact of their being horizontal be any proof that the inclination of their orbit is small, and their being vertical a proof that it is much greater, and of a somewhat similar angle? But this would not explain the fact of the majority being horizontal the first night and the majority at a greater angle the next night, One seen on the 20th was intermittent, it ran for a long distance, and became visible at intervals of a few seconds a little way further on. Only a few were of any size, and the first night all but two were extremely small and very faint, with very short tracks. The next night they were not only greater in number but larger, brighter, and with longer tracks. A few left tracks lasting a second or two. One only moved very fast. The first night there was one quite vertical *upwards*. This was the only instance. The majority were from E. to S. or E. to W. on both nights; and the only two of any length on the 19th were one running out of Corona and one running into it. It seemed curious to me how these should be so much longer than all the others and yet lie so close to the point of apparent divergence of them all. The following is a list for the two nights of the number in each 15 minutes: April 19.—From 11.45 to 12, 2; 12.15, 5; 12.30 2; 12 45, 2; 13, 1; 13.15, 5; 13.30, 1; 13.45, 0; 14, 3; 14.15, 2; 14.30, 0; 14.45, 1; 15, 1; 15 to 15.30, 0; Total: 25.

April 20.—From 9.45 to 10, 1; 10.15, 3; 10.30, 1; 10.45, 0; 11, 5; 11.15, 2; 11.30, 2; 11.45, 1; 12, 0; 12.15, 1; 12.30, 1; 12.45, 1; 13, 2; 13.15, 4; 13.30, 2; 13.45, 2; 13.45 to 14.30, 0; 14.45, 5; Total: 33. P. B.

Bath

Instinct

A Mechanical Analogy

MR. DARWIN, in his article on "The Origin of certain Instincts," in NATURE, of April 3, appears inclined to think that what we may call the instinct of direction in animals is of the same kind as the faculty by which men find their way: and he instances the power of the natives of Siberia to find their way over hummocky ice. He afterwards, however, raises without discussing the question "whether animals may not possess the faculty of keeping a dead reckoning of their course in a much more perfect degree than man, or whether this faculty may not come into play on the commencement of a journey when an animal is shut up in a basket." I wish to point out that this peculiar power of animals is one that cannot be explained as a higher degree of any power that man possesses. What man can do is to find the third side of a triangle after travelling the other two sides *with his eyes open*. Animals can do the same after travelling the two sides *with their eyes shut*. The former power does not in any degree involve the latter. Moreover, the power of man here spoken of depends on the careful use of his powers of observation. This does not appear to be the case with animals. Among the many instances of animals finding their way home after being conveyed away without any opportunity of seeing their way or taking their bearings, there must in all probability be many in which the animal slept on the journey: and if so, the mental or organic process whereby it was able to know its way back must have gone on during sleep. There is nothing in man's mind similar to such a process as this. It can be made conceivable only by a mechanical analogy, if at all.

If a ball is freely suspended from the roof of a railway carriage, it will receive a shock sufficient to move it, when the carriage is set in motion: and the magnitude and direction of the shock thus given to the ball will depend on the magnitude and direction of the force with which the carriage begins to move. While the carriage is in uniform motion the ball will be relatively at rest; and every change in the velocity of the motion of the carriage, and of its direction, will give a shock of corresponding magnitude and direction to the ball. Now, it is conceivably quite possible, though such delicacy of mechanism is not to be hoped for, that a machine should be constructed, in connection with a chronometer, for registering the magnitude and direction of all these shocks, with the time at which each occurred; and from these data—the direction of the shock indicating the direction of the motion of the carriage, the magnitude of the shock indicating its velocity, and the interval of time between two shocks indicating the time during which the carriage has run without change of velocity or direction—from these data the position of the carriage, expressed in terms of distance and direction from the place from which it had set out, might be calculated at any moment. The automatic register of the journey may be conceived as exactly resembling the records of the velocity and direction of the wind produced by one of Robinson's or Beck's self-registering anemometers, where one pencil-mark indicates the direction of the wind, at any past hour, and another its velocity.

Further, it is possible to conceive the apparatus as so integrating its results as to enable the distance and direction of the point where the journey began to the point it has reached, that they can be read off, without any calculation being needed:—a hand on a dial pointing to the direction expressed in degrees of the circle, and the distance being shown in figures expressing miles and decimals of a mile.

Now, I suppose such an integrating process as this (though of course not by any similar mechanism) to be effected in the brain of an animal unconsciously, and that the animal has the power of reading off the result—that is to say, bringing it into consciousness when wanted. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, co. Antrim, April 11

Sense of Orientation

YOUR article on this subject in the issue of March 20, insists very properly on the objection to Mr. Wallace's theory that "if it be solely by the aid of this memory of smells that the dog is to return to the place whence it was taken, it must needs *make haste* back." I wish to contribute an anecdote of which the hero did not make haste back, and which seems to me to confirm rather the theory already suggested in this correspondence, namely, of a sense of polarity or *orientation* possessed by so many of the lower animals both domesticated and wild. Last summer I was at North Bridgewater, Mass., a shoe-making town about twenty miles south of Boston. At the railroad station I remarked an intelligent dog, whose owner told me, with a good deal of feeling, that he had sold the animal some time previously to be taken to Somerville—a suburb adjoining Boston on the north-west, therefore distant from North Bridgewater at least twenty miles. The dog was carried thither in a closed box-car, probably making a change at Boston, where the railroad terminates. For some two or three weeks the dog made himself at home in his new premises as if perfectly contented, when suddenly he disappeared, and turned up again not at North Bridgewater, the home of his former owner, but at Bridgewater, a mile or two farther south, where he had been raised, at the house of that owner's father; evidently not meaning to be sold again.

I am not sure that it is quite germane to this discussion to call attention to the fact pointed out by the late George Catlin in his "Life amongst the Indians" (p. 96), "that the wild horse, the deer, the elk, and other animals, never run in a straight line: they always make a curve in their running, and generally (but not always) to the left."

"I never have forgotten one of the first lessons that I had from my dear friend Darrow, in deer-stalking in the forest. 'George,' said he, 'when a deer gets up, if the ground is level, never follow him, but turn to the left, and you will be sure to meet him; he always runs in a curve, and when he stops he is always watching his back track.' But *man* 'bends his course;' man, lost in the wilderness or on the prairies, travels in a curve, and always bends his curve to the *left*; why this?"

Of the latter fact Mr. Catlin gives an illustration drawn from his own experience, and adds:

"On arriving at the Sioux village, and relating our singular adventure, the Indians all laughed at us very heartily, and all the chiefs united in assuring me that whenever a man is lost on the prairies he travels in a circle; and also that he invariably turns to the *left*; of which singular fact I have become doubly convinced by subsequent proofs similar to the one mentioned."

New York, April 8 N. Y.

UNITED STATES SIGNAL SERVICE

THE United States Signal Service Bureau has rapidly risen to great and deserved importance. The chief officer, General Albert J. Meyer, is a physician by education, who, during the civil war, was placed at the head of the Signal Corps. In that position he rendered great service, and developed a remarkably complete system of signals. The service now consists of a school of instruction, a central office at Washington, and stations over the country at such points as will enable the observers to note accurately the varying conditions of temperature and the progress of storms. The school is at Fort Whipple, Virginia. "A principal duty of the school has been the drill and instruction of the Observer-Sergeants and the assistant observers for the signal service. In the preparation for these duties each man is required to enlist in the signal detachment at Fort Whipple as a private soldier, and to pass afterwards a preliminary educational examination before he is put under especial instruction. He is then given some knowledge of the theories of meteorology, and is taught the practical use of the various instruments, forms, &c., in vogue at the several stations of observation, while he is practised at the same time in his regular drills of the service. When considered competent he is ordered as an assistant observer to a station where, in addition to perfecting himself in the practical details of the duties at the station, he continues his studies, regularly under the Observer-Sergeant in charge. A service of six months in this capacity renders an assistant eligible as a candidate for promotion. He may then be ordered back to the school to review his studies, and to appear for his final examination before a board of officers appointed for the purpose. Passing this examination, he is promoted to the grade of observer-sergeant, and is considered competent to take charge of a station. This course has been followed successfully during the past year, and each man's fitness has been clearly determined by this probationary service as assistant before his assignment to a more responsible position.

The central office at Washington is in telegraphic communication with all the stations, and each night reports are received at 11 o'clock, P.M., and the results of the digest are telegraphed to all the principal cities in time for the daily morning papers.

From a detailed report of the operations of each of the established stations it appears that during the year there have been issued and distributed at the different lake, sea-coast, and river ports, and in the inland cities a total number of bulletins, maps, &c., as follows:—

Total number of bulletins . . .	187,617
Total number of maps	203,533
Total number of Press reports . .	50,878

The accuracy of the predictions of the Bureau as to the weather changes is stated in the report as follows:—"A comparison of the tri-daily forecasts, or 'probabilities,' as they have been styled, with the meteoric condition afterward reported, and, so far as known, has given an average of sixty-nine per cent., as verified up to November 1, 1871. Since that date to the present time (October 1, 1872) the average of verifications has been seventy-six and eight-tenths per cent. If regard be had to those predictions verified, within a few hours after the time for which they were made, this percentage is considerably increased. In view of the deficiency of telegraphic facilities during the year, and the great irregularities of the working, it was not anticipated that these predictions, based as they are upon the tri-daily telegraphic reports, would increase in accuracy. Whatever success has been attained must be considered an indication of what success might be with well organised and full telegraphic facilities."

The number of "cautionary" signals on the inland lakes and on the sea-coast, and their value are thus stated:—"Three hundred and fifty-four cautionary signal orders have been issued during the year, each display of the cautionary signal at any station being considered a separate order. This signal was announced as to be shown 'whenever the winds are expected to be as strong as 25 miles an hour, and continue so for several hours within a radius of 100 miles from the station.' The percentage of the cautionary signals verified by the occurrence within a few hours after the display of the winds described, either at the port at which the signal was exhibited, or within the radius of 100 miles from that port, is estimated to have been about 70 per cent. The instances of signals displayed, reports not verified, are those in which they have not been proven necessary at the station where exhibited. The signal is wholly 'cautionary,' forewarning probable danger. It has been aimed to err on the side of caution. The delays such errors may cause are retrievable—the disasters of shipwreck are not. Since the 1st of July of the present year (1872) thirty-two cautionary signals, forewarning the approach of six different storms, have been displayed at different ports. Of these storms five were destructive, justifying the display of twenty-eight of the signals—one in advance of which four signals were displayed was not considered dangerous."

The operations of the service have been considerably extended by co-operation of the Canadian authorities, and negotiations are in progress designed to furnish signal reports from the West India Islands, and even from Europe.

THE ZOOLOGICAL AND ACCLIMATISATION SOCIETY OF VICTORIA

THE first volume of the Proceedings of this Society, contains upwards of 400 pages, and the prefixed report is altogether very satisfactory. The council of the society rightly think that Melbourne, from its size and importance, ought to number among its attractions a good zoological collection. If they succeed in obtaining a sufficiently large number of subscribers, they intend, in the first instance, to form as complete a collection as possible of the fauna of Australia, and thereafter, when in a position to do so, to add those of other countries. The Government, we are glad to see, very liberally placed the sum of 1,000*l*. on the estimate for the past financial year.

A considerable amount of success attended the operations of the society during the year previous to March last. A number of pheasants of the silver (*Phaseanus nycthemerus*) and common (*Phaseanus colchicus*) varieties, had been reared, and were to be liberated in suitable places. Upwards of 150 guinea-fowl had been placed in various secluded spots, in forests far removed from settlement, where it is confidently hoped they will increase, and in a few years yield both food and sport.

About 3,500 live trout, hatched at the society's establishment at the Royal Park, Melbourne, had, during the previous season, been placed in different streams. The deer which have been liberated in many parts of the colony are spreading and increasing rapidly, and the society possess a fine collection of six varieties in their grounds at the Royal Park. The valuable stock of Angora goats and the ostriches belonging to the society are thriving and increasing.

Although the society is anxious to encourage and promote sericulture, they find it difficult to advance this industry in a really practical manner so as to be of benefit to the colony. Baron von Mueller has, however, as well as the society, supplied many parts of the colony with white mulberry plants, and when they come into bearing, silk growing will, they hope, become an important industry of the colony.

On account of the services rendered to pisciculture by Sir Robert Officer and Mr. Morton Allpart, of Tasmania, the society have awarded to both these gentlemen their silver medal; their bronze medal has been awarded to Captain Babot, of the *Hydrastes*, for his enterprise in bringing out sea-turtle.

In conclusion, the council are glad to state that the condition of the society is sound and prosperous, and they only require more liberal co-operation from the public to enable them to produce great results in the cause of acclimatisation. We sincerely hope the Australian public will see it to be to their own interest to respond liberally to the desire of the society for assistance in carrying out their benevolent work.

The bulk of the volume is occupied by two papers. The first is a valuable monograph on the "Ichthyology of Australia," by Count F. de Castelnau, in which he gives an account of the different sorts obtainable in the Melbourne fish market: their number is 142. In the introduction the author speaks with great admiration of Dr. Günther's Catalogue of the Fishes in the British Museum, from which he has continually to quote; further on, he criticises that author's views on the distribution of fishes. He also thinks that the learned doctor is too severely condemnatory of the imperfections of his scientific comrades. The second paper is a list by Baron F. v. Mueller of "Select plants readily eligible for Victorian industrial culture."

NEW FRENCH INSTITUTION FOR THE EXPERIMENTAL SCIENCES

AMID all her political turmoil and strife it seems to us a hopeful sign of the real progress of France that she has citizens with energy, enterprise, and enlightenment enough to undertake and carry out a scheme of the magnitude and importance of the one about to be realised at Lyons. It is to be exclusively devoted to scientific research, and the *Revue Scientifique* thinks it deserves to be classed with the richest establishments of a similar kind in England, Germany, and Paris.

For more than a year, it seems, the municipal administrators of Lyons have had it under consideration to form laboratories of physiology and experimental medicine, provided with all the most modern and most approved means of investigation. To settle the plan of such an institution, the muncipality nominated a Commission of scientific men, consisting of MM. Ollier, Perroud, and Tripier. This Commission has given in its report, and the following is the scheme it suggests with regard to the biological sciences alone:—

1. A great central laboratory, equipped for the operations and observations which are required in the experimental study of the physiological and pathological phenomena of the animal economy. In it will be collected and methodically arranged all the instrumental apparatus commonly required for such observations and experiments, especially the registering apparatus.
2. A central hall or store-house of apparatus. This will be the depôt for apparatus and instruments not in daily use, and which are used only in certain circumstances.
3. A laboratory of biological chemistry.
4. A laboratory of biological physics.
5. A laboratory of histology.
6. A room for geological researches relative to the study of parasites and parasitical diseases, including those of the silkworm.
7. A room for autopsies.
8. A room for minute dissections and for the mounting of specimens intended to be preserved.
9. A workshop for construction and repairs, in which will also be set agoing the moving forces intended to work the apparatus.
10. A cabinet of specimens.

11 and 12. A room of design and a small photographic studio.

13. A library.
14. A hall for meetings and lectures.
15. Places for keeping animals.
16. A conservatory and enclosure for researches in vegetable physiology.
17. General offices, houses for the director and assistants, for fuel, water, &c.

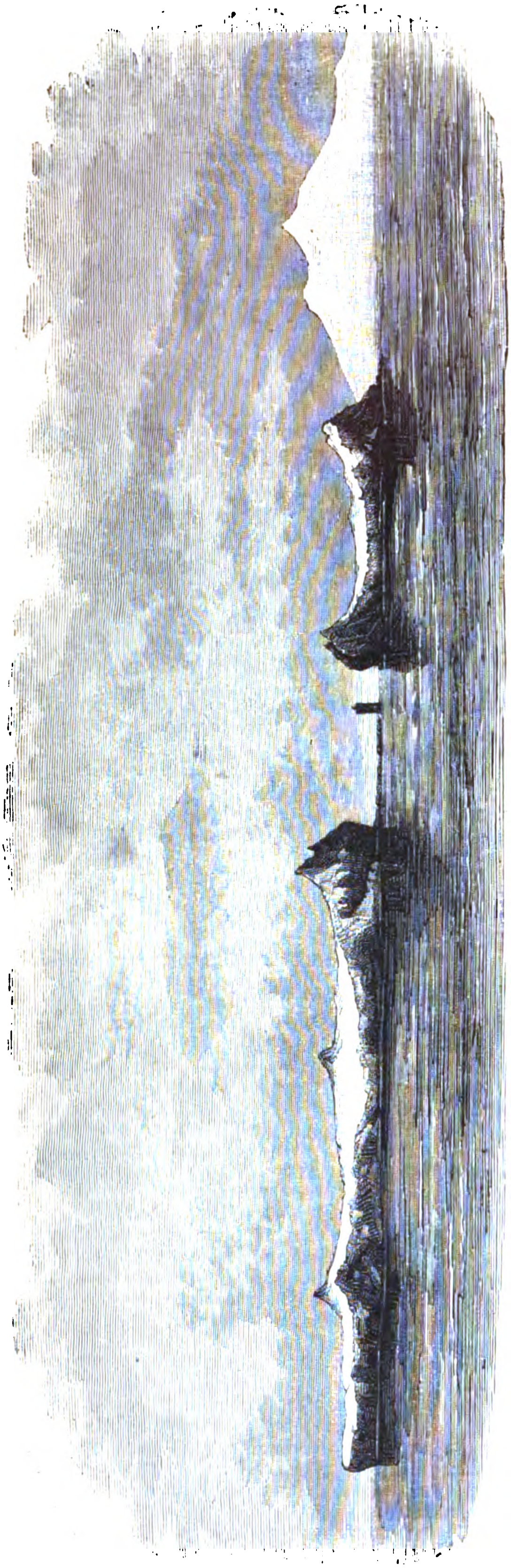
The *personnel* comprehends a director and his assistant, a librarian, who will also see to the publication of the works of the establishment, three assistants, one for operations and autopsies, the second for work in biological physics and chemistry, and the third for microscopic studies and work in experimental zoology; finally workmen, laboratory attendants, concierge, groom, &c.

These laboratories are intended for the study of all the branches of the biological sciences, from general and comparative physiology to experimental medicine, questions of hygiene and public health, diseases of animals (especially silkworms), and vegetable physiology.

But, although specially intended as an institution for the biological sciences, the Commission has indicated that the programme would be rendered complete by adding a physico-chemical institute for the study of brute nature, so as to unite in the same establishment the whole body of modern experimental sciences.

On March 7 the Maire of Lyons presented to the Municipal Council a report asking that the scheme be immediately proceeded with. The city of Lyons has presented the grounds of the ancient corn-market on the Quai St. Vincent. According to the plans and estimates of the city architect, the buildings will cost 900,000f., of which this year 330,000f. have been raised. Finally, for the biological sciences alone, a first annual budget of 30,000f. has been set aside.

These figures speak for themselves, and need no comment.



Possession Islands. From a sketch by Dr. Hooker, C.B., F.R.S.

POSSESSION ISLANDS

SEEING is believing. The fitness of Possession Islands for the residence of an observing party during a whole year may be best judged from the accompanying illustration, which is accurately copied from a sketch made by Dr. Hooker at the time a landing was effected. (See NATURE, vol. vii. p. 384.) This was *in midsummer*, and with an exceptionally calm sea. The spot where the crew landed is indicated by an * underneath. A sketch of the place by Captain Davis is given at the beginning of chapter vii. in the first volume of Ross's Voyage.

ON THE ORIGIN AND METAMORPHOSES OF INSECTS*

II.

IN the Coleoptera, the larvæ differ very much in form. The majority are elongated, active, hexapod, and more or less depressed; but those of the Weevils (Pl. 2, Fig. 6), of Scolytus, (Pl. 2, Fig. 4), &c., which are vegetable feeders, and live surrounded by their food, as, for instance, in grain, nuts, &c., are apod, white, fleshy grubs, not unlike those of bees and ants. The larvæ of the Longicorns, which live inside trees, are long, soft, and fleshy, with six short legs. The Geodephaga, corresponding with the Linnean genera Cicindela and Carabus, have six-legged, slender, carnivorous larvæ; those of Cicindela, which waylay their prey, being less active than the hunting larvæ of the Carabidæ. The Hydradephaga, or water-beetles (Dyticidæ and Gyrinidæ) have long and narrow larvæ (Pl. 4, Fig. 6), with strong sickle-shaped jaws, short antennæ, four palpi, and six small eyes on each side of the head; they are very voracious. The larvæ of the Staphylinidæ are by no means unlike the perfect insect, and are found in similar situations; their jaws are powerful, and their legs moderately strong. The larvæ of the Lamellicorn beetles (cockchafers, stag-beetles, &c.) feed either on vegetable or on dead animal matter. They are long, soft, fleshy, grubs, with the abdomen somewhat curved, and generally lie on their side. The larvæ of the Elateridæ, known as wireworms, are long and slender, with short legs. Those of the glowworm are not unlike the apterous female. The male glowworm, on the contrary, is very different. It has long, thin, brown wing-cases, and often flies into rooms at night, attracted by the light, which it probably mistakes for its mate.

The metamorphoses of the Cantharidæ are very remarkable, and will be described subsequently. The larvæ are active and hexapod. The Phytophaga (Crioceris, Galeruca, Haltica, Chrysomea, &c.) are vegetable feeders, both as larvæ and in the perfect state. The larvæ are furnished with legs, and are not unlike the caterpillars of certain Lepidoptera.

The larva of Coccinella (the Ladybird) is somewhat depressed, of an elongated ovate form, with a small head, and moderately strong legs. It feeds on Aphides.

Thus, then, we see that there are among the Coleoptera many different forms of larvæ. Macleay considered that there were five principal types.

1. Carnivorous hexapod larvæ, with an elongated, more or less flattened body, six eyes on each side of the head, and sharp falciform mandibles (Carabus, Dyticus, &c.).

2. Herbivorous hexapod larvæ, with a fleshy, cylindrical body, somewhat curved, so that the animal lies on its side (Lucanus, Melolontha).

3. Apod grub-like larvæ, with scarcely the rudiments of antennæ (Curculio).

4. Hexapod antenniferous larvæ, with a subovate body, the second segment being somewhat larger than the others (Chrysomela, Coccinella).

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* Continued from p. 446.

5. Hexapod antenniferous larvæ, of oblong form, somewhat resembling the former, but with caudal appendages (Meloe, Sitaris).

The pupa of the Coleoptera is quiescent, and * "the parts of the future beetle are plainly perceivable, being incased in distinct sheaths; the head is applied against the breast; the antennæ lie along the sides of the thorax; the elytra and wings are short and folded at the sides of the body, meeting on the under side of the abdomen; the two anterior pairs of legs are entirely exposed, but the hind pair are covered by wing-cases, the extremity of the thigh only appearing beyond the sides of the body."

In the next three orders, the Orthoptera (grasshoppers, locusts, crickets, walking-stick insects, cockroaches, &c.), Euplexoptera (earwigs), and Thysanoptera, a small group of insects well known to gardeners under the name of Thrips, the larvæ when they quit the egg (Pl. 1 and 2, Figs. 1 and 2) already much resemble the mature form, differing in fact principally in the absence of wings, which are more or less gradually acquired, as the insect increases in size. They are active throughout life. Those specimens which have rudimentary wings are, however, usually called pupæ.

The Neuroptera present, perhaps, more differences in the character of their metamorphoses than any other order of insects. The larvæ are generally active, hexapod, little creatures, and do not differ in appearance so much as those, for instance, of the Coleoptera, but the essential difference is in the pupæ; some groups, as, for instance, the Psocidæ, Termitidæ, Libellulidæ, Ephemeridæ, and Perlidæ, remaining active throughout life, like the Orthoptera; while a second division, including the Myrmeleonidæ, Hemerobiidæ, Sialidæ, Panorpidæ, Raphidiidæ, and Mantispidæ, have quiescent pupæ, which, however, in some cases, acquire more or less power of locomotion shortly before they assume the mature state; thus, the pupa of Raphidia, though motionless at first, at length acquires strength enough to walk, while still enclosed in the pupa skin, which is very thin.†

One of the most remarkable families belonging to this order is that of the Termites, or white ants. They abound in the tropics, where they are a perfect pest, and a serious impediment to human development. Their colonies are extremely numerous, and they attack woodwork and furniture of all kinds, generally working from within, so that their presence is often unsuspected, until it is suddenly found that they have completely eaten away the interior of some post or table, leaving nothing but a thin outer shell. Their nests, which are made of earth, are sometimes ten or twelve feet high, and strong enough to bear a man. One species, *Termes lucifugus*, is found in the South of France, where it has been carefully studied by Latreille. He found in these communities five kinds of individuals—(1) males; (2) females, which grow to a very large size, their bodies being distended with eggs, of which they sometimes lay as many as 80,000 in a day; (3) a kind described by some observers as Pupæ, but by others as neuters. These differ very much from the rest, having a long, soft body without wings, but with an immense head, and very large, strong jaws. These individuals act as soldiers, doing apparently no work, but keeping watch over the nest and attacking intruders with great boldness. (4) Apterous, eyeless individuals, somewhat resembling the winged ones, but with a larger and more rounded head; these constitute the greater part of the community, and like the workers of ants and bees, perform all the labour, building the nest and collecting food. (5) Latreille mentions another kind of individual which he regards as the pupa, and which resembles the workers, but has four white tubercles on the back, where the wings will afterwards make their appearance. There is still, however, much difference of opinion among entomologists, with reference to the true nature of these different classes of individuals. M. Lespés, moreover, who has recently studied the same species, describes a second kind of male and a second kind of female. The subject, indeed, is one which offers a most promising field for future study.

Another interesting family of Neuroptera is that of the Ephemeræ, or mayflies (Pl. 3, Fig. 1), so well known to fishermen. The larvæ (Pl. 4, Fig. 1) are semi-transparent, active, six-legged little creatures, which live in water, and having at first no gills, respire through the general surface of the body. They grow rapidly and change their skin every few days. After one or two moults they acquire seven pairs of branchiæ, or gills, which are in the form of leaves, one pair to a segment. When they are about half grown, the posterior angles of the two posterior thoracic segments begin to elongate. These elongations become more and more marked with every skin. One morning, in the month of June, some years ago, I observed a full-grown larva, which had a glistening appearance, owing to the pre-

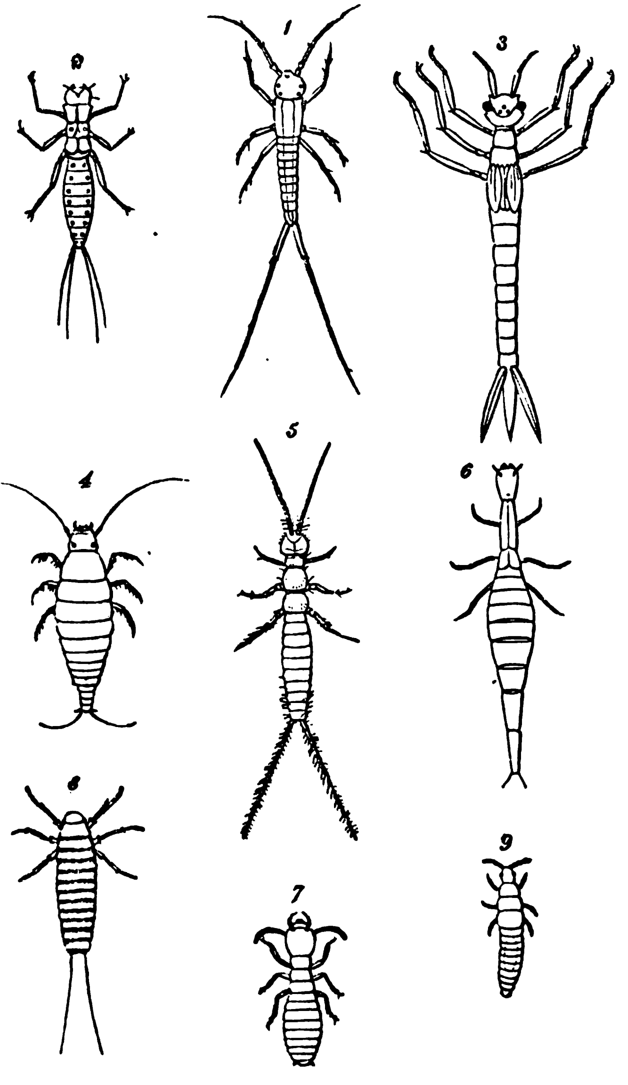

PLATE 4

PL. 4.—FIG. 1, Larva of Chloeon. 2, Larva of Meloe (after Chapuis Candeze). 3, Larva of Calepteryx (after Leon Dufour). 4, Larva of Sitaris 5, Larva of Campodea (after Gervais). 6, Larva of Acilius. 7, Larva of Termes (after Blanchard). 8, Larva of Stylops. 9, Larva of Thrips.

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* Westwood's Introduction, vol. i. p. 36.

† Ibid. vol. ii. p. 52.

sence of a film of air under the skin. I put it under the microscope, and then, having added a drop of water with a pipette I put the instrument down and looked through the glass. To my astonishment, the insect was gone, and an empty skin only remained. I then caught a second specimen, in a similar condition, and put it under the microscope, hoping to see it come out. Nor was I disappointed. Very few moments had elapsed, when I had the satisfaction of seeing the thorax open along the middle of the back; the two sides turned over; the insect literally walked out of itself, unfolded its wings, and in an instant flew up to the window. Several times since, I have had the pleasure of witnessing this wonderful change, and it is really extraordinary how rapidly it takes place; from the moment when the skin first cracks, not ten seconds are over before the insect has flown away.

The Dragon-flies, or Horse-stingers, as they are sometimes called, from a mistaken idea that they sting severely enough to hurt a horse, though in fact they are quite harmless, also spend their early days in the water. The larvæ are brown, sluggish, ugly creatures, with six legs. They feed on small water animals, for which they wait very patiently, either at the bottom of the water or on some water plant. The lower jaws are attached to a long folding rod, and when any unwary little wretch approaches too near the larva, this apparatus is shot out with great velocity, and the prey which comes within its reach seldom escapes. In their perfect condition, also, Dragon-flies feed on other insects, and may often be seen hawking round ponds. The so-called Ant-lion in many respects resembles the Dragon-flies, but the habits of the larvæ are very dissimilar. They do not live in the water, but prefer dry places, where they bury themselves in the loose sand, and seize any little insect which passes, with their long jaws. The true Ant-lion makes itself a little pit in loose ground or sand, and buries itself at the bottom. Any inattentive little insect which steps over the edge of this pit immediately falls to the bottom, and is instantaneously seized by the Ant-lion. Should the insect escape and attempt to climb up the side of the pit, the Ant-lion is said to throw sand at it, knocking it down again.

One other family of Neuroptera I must mention, the Hemerobiidæ. The perfect insect is a beautiful, lace-winged, very delicate, green insect, something like a tender Dragonfly, and with bright green, very touching eyes. The females deposit their eggs on plants, not directly on the plant itself, but attached to it by a long white slender footstalk. The larvæ have six legs and powerful jaws, and make themselves very useful in destroying the Hopfly.

The insects forming the order Trichoptera are well known in their larval condition, under the name of caddis worms. These larvæ are not altogether unlike caterpillars in form, but they live in water—which is the case with very few lepidopterous larvæ—and form for themselves cylindrical cases or tubes, built up of sand, little stones, bits of stick, leaves, or even shells. They generally feed on vegetable substances, but will also attack minute freshwater animals. When full grown, the larva fastens its case to a stone, the stem of a plant, or some other fixed substance, and closes the two ends with an open grating of silken threads, so as to admit the free access of water, while excluding enemies. It then turns into a pupa, which bears some resemblance to the perfect insect, "except that the antennæ, palpi, wings and legs are shorter, enclosed in separate sheaths and arranged upon the breast." The pupa remains quiet in the tube until nearly ready to emerge, when it comes to the surface, and in some cases creeps out of the water. It is not therefore so completely motionless as the pupa of Lepidoptera.

The Diptera, or Flies, comprise insects with two wings only, the hinder pair being represented by minute club-shaped organs called halteres. Flies quit the egg generally in the form of fat, fleshy, legless grubs. They feed principally on decaying animal or vegetable matter, and are no doubt useful as scavengers. When full grown they turn into pupæ which are generally inactive; those of some gnats, however, swim about. Other species, as the gadflies, deposit their eggs on the bodies of animals, within which the grubs, when hatched, feed. The mouth is generally furnished with two hooks which serve instead of jaws. The pupæ are of two kinds. In the true flies, the outer skin of the full-grown larva is not shed, but contracts and hardens, thus assuming the appearance of an oval brownish shell or case, within which the insect changes into a chrysalis. The pupæ of the gnats, on the contrary, have the limbs distinct and enclosed in sheaths. They are generally inactive, but some of the aquatic species continue to swim about.

One group of Flies, which is parasitic on horses, sheep, bats, and other animals, has been called the Pupipara, because it was supposed that they were not born until they had arrived at the condition of pupæ. They come into the world in the form of smooth ovate bodies, much resembling ordinary dipterous pupæ, but as Leuckart has shown,* they are true, though abnormal, larvæ.

The next order, that of the Aphaniptera, is very small in number, containing only the different species of Flea. The larva is long, cylindrical, and legless; the chrysalis is motionless, and the perfect insect is too well known, at least as regards its habits, to need any description.

Unlike the preceding orders of insects, the Heteroptera quit the egg in a form, differing from that of the perfect insect principally in the absence of wings. The species constituting this group though very numerous, are generally small, and not so familiarly known to us as those of the other large orders, with indeed one exception, the well-known Bug. This was not, apparently, an indigenous insect, but seems to have been introduced. Shakespeare uses the word several times, but always in the sense of a bugbear, and not with reference to this insect. In this country it never acquires wings, but is stated to do so sometimes in warmer countries. The Heteroptera cannot exactly be said either to sting or bite. The jaws, of which, as usual among insects, there are two pairs, are like needles, which are driven into the flesh, and the blood is then sucked up the lower lip, which has the form of a tube. This peculiar structure of the mouth prevails throughout the whole order; consequently their nutriment consists almost entirely of the juices of animals or plants. In their metamorphoses the Heteroptera resemble the Orthoptera; they are active through life, and the young resemble the perfect insects except in the absence of wings, which are gradually acquired. The majority are dull in colour, though some few are very beautiful. The Homoptera agree with the Heteroptera in the structure of the mouth, and in the metamorphoses. They differ principally in the front wings, which in Homoptera are membranous throughout, while in the Heteroptera the front part is thick. As in the Heteroptera, however, so also in the Homoptera, some species do not acquire wings. The Cicada, so celebrated for its song, and the lanthorn fly, belong to this group. So also does the so-called Cuckoospit, so common in our gardens, which has the curious faculty of secreting round itself a quantity of frothy matter which serves to protect it from its enemies. But the best known insects of this group are the Aphides, or Plant-lice; while the most useful belong to the Coccidæ, or scale insects, from one species of which we obtain the substance called lac, so extensively used in the manufacture of sealing-wax and varnish. Several species also have been used in dyeing, especially the Cochineal insect of Mexico, a species which lives on the Cactus. The male Coccus is a minute, active insect, with four comparatively large wings, while the female, on the contrary, never acquires wings, but is very sluggish, broad, more or less flattened, and, in fact, when full grown, looks like a small brown scale.

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* Die Fortpflanzung und Entwickelung der Pupiparen. Von Dr. R. Leuckart. (Halle, 1848.)

The larvæ of Lepidoptera are familiar to us all, under the name of caterpillars. The insects of this order in their larval condilion are almost all phytophagous, and are very uniform both in structure and habits. The body is long and cylindrical, consisting of thirteen segments; the head is armed with powerful jaws; the three following segments, the future prothorax, mesothorax, and metathorax, bear three pairs of simple articulated legs. Of the posterior segments, five also bear false or pro-legs, which are short, unjointed, and provided with a number of hooklets. A caterpillar leads a dull and uneventful life; it eats ravenously, and grows rapidly, casting its skin several times during the process, which generally lasts only a few weeks, though in some cases, as for instance the goat-moth, it extends over a period of two or three years, after which the larva changes into a quiescent pupa or chrysalis.

JOHN LUBBOCK

(*To be continued.*)

ON THE STRUCTURE OF STRIPED MUSCULAR FIBRE

A HIGHLY interesting paper on the above subject was read before the Royal Society on April 3, by Mr. E. A. Schäfer, of University College. The muscle of the limbs of the large water-beetle formed the subject of the investigation, and it was examined immediately after removal from the living animal, without the addition of any reagent, to prevent the introduction of complications. According to the author, a muscular fibre consists of a homogeneous ground substance, which appears at first sight to be formed of two distinct substances, one dim and the other bright, arranged in alternate discs at right angles to the direction of the fibre; and a vast number of minute rod-like bodies, imbedded in the protoplasmic basis, having their axes coincident with that of the fibre itself. These are termed *muscle-rods*; in the muscle at absolute rest they are uniformly cylindrical, and produce the appearance of a simple longitudinal fibrillation in the fibre, with no transverse striping. But when in action these muscle-rods are terminated at each extremity by a knob, and are consequently dumb-bell shaped. It is these knobs which give the appearance of the line of dots which is always described as existing in the middle of each bright transverse band of the muscle fibre, whereas the dim one is that in which the shafts of the muscle-rods are imbedded. In contraction of the muscle, the heads of the rods become enlarged at the expense of the shafts, the extremities of each muscle-rod consequently approaching one another; and the enlarged heads come nearer to their neighbours of the same series, and to those of the next series which meet them in the bright stripe, the line of dots now appearing as a dark transverse band with bright borders. As contraction proceeds the shaft of the muscle-rod tends to, and ultimately disappears, leaving an appearance of alternate dark and light stripes; the former however are in this case due to the enlarged juxtaposed extremities of the rods, the latter on the other hand being mainly due to the accumulation of the ground-substance in the intervals between their shafts. An examination of minute oil-globules imbedded in gelatine shows clearly that they give the appearance under the microscope of dark spots with a brilliant surrounding, and several side by side produce the effect of a bright band. From many considerations it can be shown that the bright transverse bands in muscle are similarly produced by the juxtaposition of the rod-heads, among which are the following:—1. When the rod-heads are smaller the bright bands are narrower. 2. When the rod-heads have become merged with the shafts in full contraction, the bright transverse stripes entirely disappear. 3. When in contraction the rod-heads enlarge and encroach on the shaft, their bright borders accompany them and encroach on the dim substance, so that at last all appearance of dimness becomes entirely obliterated, the bright borders becoming blended in the middle. 4. The part of the muscle-rod where the head joins the shaft, is rendered indistinct by the brightness around the rod-head; whereas if this brightness were inherent in the ground-substance, this part of the rod would stand out all the darker by the contrast. 5. The appearance of a transverse section is corroborated; for in this case the rod-heads are seen so close together that the optical effect of any one would become merged into those of its neighbours: consequently the whole of the intermediate substance would appear bright; and this is actually found to be the case. 6. The fact that both the dim and the bright substance of resting muscle appear doubly refracting, would indicate that they are of the same nature.

Mr. Schäfer with polarised light has found that *all* the ground-substance of the fibre is doubly refractive, the rods alone being singly refractive. He concludes the paper by offering a conjecture as to the mode of muscular contraction, in which he is inclined to regard the ground-substance as the true contractile part, and the rods as elastic structures, merely serving to restore the fibre to its original length.

NOTES

A RUMOUR as to the fate of Sir Samuel and Lady Baker, of a kind similar to those which have ever and anon filled the air with reference to the undying Livingstone, appeared in the *Times* of Thursday last. At the end of last year, with his force dwindled down to 200 men, Sir Samuel had penetrated south until he had reached the territory of the chief of the tribes squatting near the great lakes, who had hitherto been friendly to the Egyptian government. His reception of Baker and his companions was however the reverse of friendly. Whatever the cause, a desperate conflict with the natives ensued, and after much hard fighting, Baker was compelled to retreat with but 30 out of his 200 men. It was with the utmost difficulty that the survivors succeeded in intrenching themselves in a small fort, whence to beat back further attacks. Such, according to report, was the state of matters at the end of last year. The present rumour is that Sir Samuel and Lady Baker having at last been compelled to surrender, were immediately afterwards murdered. A telegram from H.M. Consul at Alexandria, dated the afternoon of last Thursday, announces that no intelligence of any sort respecting Sir Samuel and Lady Baker had been received by the Egyptian Government, or by any other, since March 5 last. A telegram of April 19, from the Alexandria *Daily News* Correspondent states that the rumour seems to be utterly unfounded. We have, moreover, been assured by one who has the best opportunities of knowing, that no news has really been received, and that the reports about Sir Samuel are inventions: "there is not," he writes us, "a word of truth in them."

WE regret to announce that Baron Liebig's illness, to which we referred last week, has terminated in death. The great chemist died on the 18th instant, aged nearly 70 years, having been born at Darmstadt on May 12, 1803. His funeral took place with great ceremony at Munich on the 21st. We hope, in an early number, to be able to give a memoir of the late Baron.

IT is with the greatest regret that we announce the death, on the 20th inst., after a long, and latterly, severe illness, of Dr. Bence Jones, Secretary to the Royal Institution, the efficiency of which he has done much to promote. Dr. Jones was a distinguished chemist, and among his contributions to the advancement of science may be mentioned his Croonian Lectures on Matter and Force, Animal Chemistry in relation to Stomach and

Renal Diseases, Lectures on Pathology and Therapeutics, &c. His reputation has been latterly much extended by his work on the early history of the Institution, and by his excellent biography of Faraday. Dr. Jones was a member of many learned and scientific societies, at home and abroad. It will not be easy for the managers of the Royal Institution to find one capable of so efficiently discharging the duties of Secretary. Our readers will remember that a short time ago a movement was set on foot to get up a well-deserved testimonial to Dr. Jones, which, in agreement with his own wishes, is to take the form of a bust to be placed in the Royal Institution.

DR. F. ARNOLD LEES and Mr. T. B. Blow propose to form a club under the name of the Botanical Locality Record Club, the object of which shall be to collect and keep a record of the exact localities of all the rarer British plants, with the dates of the latest observance of each, to be published yearly at the end of each season. The yearly report, containing not only a detailed list of the localities, but also a geographical summary of each year's work, is to be published and distributed only to members of the club, and to certain learned societies; to the former a subscription of 5*s.* will be charged. The names of botanists desiring to become members are to be forwarded to Mr. T. B. Blow, Welwyn, Hertfordshire.

MR. N. HOLMES, Curator of the Museum of the Pharmaceutical Society, has been appointed Lecturer on Botany to the Westminster Hospital, in the place of Mr. A. W. Bennett.

DR. ACLAND, the Regius Professor of Medicine in the University of Oxford, has given notice that the following gentlemen have been appointed to Radcliffe Studentships for the ensuing Term: Mr. A. W. Harding, of University College Hospital; Mr. Joseph H. Philpot, of King's College Hospital; Mr. William Garton, of St. Thomas's Hospital; and Mr. Frederick W. Jordan, of the Manchester Infirmary.

AMONG the works recommended by the Board of Studies in Natural Science of the University of Oxford to students preparing for examination at the University, is Sachs's "Lehrbuch der Botanik." For the benefit of those unacquainted with the German language, the Delegates of the Clarendon Press have arranged with Prof. Sachs and with MM. Engelmann, of Leipzig, for an English translation of this work from the third edition, just published in Germany, and containing a large amount of additional matter; the whole of the 460 woodcuts with which the original work is illustrated will be reproduced in the English edition. The translation has been entrusted to Mr. A. W. Bennett, who will also annotate the work on points where sufficient prominence does not appear to be given to recent researches, or undue prominence seems to be asssigned to certain theories, in which part of the labour he will be assisted by Prof. Thiselton Dyer. The work is expected to be ready by about the end of the year.

THE Edinburgh Botanical Society offers a prize of ten guineas for the best and approved essay on the Reproduction of Lycopodiaceæ, to be competed for by students who have attended the botanical class of the Royal Botanic Garden, Edinburgh, during at least one of the three years preceding the award, and have gained honours in the class examinations. The author is expected to give results of practical observations and experiments made by himself on the subject, illustrated by microscopical specimens. The essay and specimens to be given in on or before May 1, 1876, with a sealed note containing the author's name, and a motto outside. Facilities will be given for carrying on observations and experiments at the Royal Botanic Garden, Edinburgh. A prize of ten guineas is offered, through the Council of the Botanical Society, by Charles Jenner, Esq., for the best and approved essay on the Structure and Reproduction of the Frondose and Foliaceous Jungermanniaceæ. This prize is subject to all the conditions specified in the case of the former.

MR. CHARLES B. PLOWRIGHT, of the Hospital, King's Lynn, proposes issuing, under the title of "Sphæriacei Britannici," a few sets, each containing one hundred specimens, intended to form a fair representation of the more important genera and species of the British Sphæriacei. The price will be 1*l.*

THE soirée of the Royal Society is to take place at Burlington House on Saturday evening next, the 26th inst.

WE regret to announce the death of Sir William Tite, M.P., at Torquay, on Sunday.

WE regret to hear of the serious illness of the Rev. George Henslow from a paralytic seizure, which has impaired the use of the lower limbs, but has not in any way affected his mental faculties, or the use of his arms. We understand that he has appointed Dr. B. T. Lowne to take his place for the present season as lecturer on Botany at Bartholomew's Hospital.

IN pursuance of the recommendation of a committee appointed at a former meeting, a conference, presided over by the Rev. H. Solly, took place on Saturday evening in further promotion of the movement for giving some of the advantages of University education to working men. The idea is to form a Guild of Operative tradesmen to arrange for the delivery of lectures in various places by lecturers provided by and sent from the University of Cambridge. Mr. Solly stated what had been done since last meeting. The Council of Trades' Delegates had passed a resolution expressing great satisfaction with the progress of the proposed scheme, while in the interviews which the chairman had had with the heads of the University every encouragement had been afforded to the project, provided that a firm organisation could be secured to deal with. The following resolution was passed:—"That, in the present defective state of technical and higher education for the workman, no adequate provision being made for those objects, either by the State or by private endeavour, this meeting hails with satisfaction the proposal to form a Trades' Guild of Learning to co-operate with the University of Cambridge and other parties willing to aid in the education of the people."

FREDERICH DAUTWITZ writes us that he will exhibit a collection of *Cactaceæ* at the Lustschloss, Schönbrunn, Vienna, where he will be glad to receive visitors. He is also desirous of effecting exchanges.

THE sum which was left as the proceeds of Prof. Tyndall's lectures in America, after paying expenses, was 13,000 dols. This balance has been placed in charge of a committee consisting of Prof. Henry, General Hector Tyndale (Prof. Tyndall's cousin), in Philadelphia, and Prof. Youmans, of New York, and these gentlemen are authorised to expend it in aid of students who devote themselves to original investigation. A suggestion has been made, and one worthy of encouragement, that efforts be initiated to secure an increase of this fund to at least 50,000 dols., the whole to bear the name of the Tyndall Fund, so that the objects of the professor may be carried out to a fuller extent.

SCIENCE is certainly in the ascendant in America at present. A fortnight ago we noted the princely gift of Mr. Anderson to Prof. Agassiz. The California Academy of Sciences has recently received from Mr. James Lick a magnificent gift of a building site in the city of San Francisco, valued at about 100,000 dollars.

FOR the purpose of more fully carrying out the law of Congress in reference to the propagation of useful food fishes in the rivers and lakes of the United States, the United States Commissioner of Fish and Fisheries made arrangements with Mr. N. W. Clark to hatch out several hundred thousand white fish eggs at his establishment at Clarkston, Michigan, with the special object of transferring them, in due season, to the waters of California. At the proper time, in February last, two hundred thousand eggs were carefully packed and forwarded to California; but, for some unexplained reason, they were nearly all dead on their arrival. In no way discouraged by this experience, the Commissioner directed the shipment of a second lot of two hundred thousand eggs, which arrived in good condition, and the greater number have since hatched out at the State hatching establishment at Clear Lake, into which body of water they will be put at the right time. The feasibility of shipping the eggs of white fish over so great a distance has now been satisfactorily solved, and there will probably be no difficulty in carrying on this work to any desirable extent. Mr. Stone has returned to the East with the view of procuring living black bass, eels, perch, and lobsters, which he will take back to California in a few weeks, in a special car arranged expressly for the purpose. The California Commissioners appear to be fully alive to the interests involved in the multiplication of the food-fishes in their State, and seem disposed to leave no method untried to accomplish this desirable object.

THE American Association for the Advancement of Science commences its twenty-second session at Portland, Maine, on Aug. 20.

THE Annual General Meeting of the Iron and Steel Institute will be held at Willis's Rooms, London, on April 29 and 30, and May 1.

PROF. O. C. MARSH has in the current number of the *American Journal of Science and Ars* done much to clear up the difficulties connected with the *Dinocerata*. He has had the opportunity of comparing his specimens with photographs of *Eobasileus* or *Loxolophodon cornutus* of Cope, for the first time, and finds that it is exactly the same as the species named by him (Marsh) *Tinoceras grandis* some time before the introduction of either of Prof. Cope's synonyms. Prof. Marsh says, "The species of *Dinocerata* at present known with certainty are the following:—*Tinoceras anceps* Marsh, *Tinoceras grandis* Marsh, *Uintatherium robustum* Leidy, *Dinoceras mirabilis* Marsh, *Dinoceras lacustris* Marsh." With regard to the osteology of the class, we are surprised to hear for the first time that in the foot the hallux is absent, and the astragalus articulates with the cuboid as well as the naviculare bone, features not Proboscidian at all.

IF we may judge from the "Register" of Lehigh University, South Bethlehem, Penns., U.S., that institution seems to be, in most respects, a model one. It was founded only a few years ago, and is the result of a magnificent gift of 500,000 dollars and 56 acres of ground, beautifully situated in the Lehigh Valley, South Bethlehem, by the Hon. Asa Packer. South Bethlehem is about fifty-four miles from Philadelphia. The education given by the staff of professors is free, the only expense to the student being his board, books, apparatus, &c. According to the plan of education laid down, the first three terms "are devoted, by all regular students, to the study of those elementary branches in which every young man should be instructed, for whatever profession or business in life he may be intended, viz., Mathematics, Languages, Elementary Physics, Chemistry, Drawing, History, Rhetoric, Logic, Declamation, and Composition." At the end of this preliminary period, by which time the Lehigh student will be not less than 17½ years old, he makes up his mind what particular direction his studies will take during the remaining five terms (2½ years) which complete the regular course. According as he decides, the student goes through the special course provided for one of the following subjects:—General Literature, Civil Engineering, Mechanical Engineering, Mining and Metallurgy, or Analytical Chemistry: three other departments have yet to be added to this special course. According to the prospectus before us, the training provided in each of the special courses is wise and thorough, and well calculated to put a diligent student in the way to make the furthest advances in the branch he adopts. Any student who wishes may pursue his studies at the University free for three years longer than the regular course. Latin and Greek are optional in all departments except that of Literature (which, by the bye, has a large infusion of physical science), while French and German are imperative in all. The institution is rendered complete by an excellent laboratory, a well-furnished observatory and a gymnasium.

PROF. PETERS has named the last two planets discovered by him, Nos. 129 and 130, Antigone and Electra.

AMONG Mr. Murray's list of forthcoming works are the following:—"The evil Effects of Interbreeding in the Vegetable Kingdom," by Charles Darwin, F.R.S.; Sir Charles Lyell's "Antiquity of Man," 4th edition; "England and Russia in the East," by Sir Henry Rawlinson, K.C.B., F.R.S.; "Human Longevity: its Facts and Fictions," by W. J. Thoms; "Personal Recollections from Early Life to Old Age," by Mary Somerville.

THE Perthshire Society of Natural Sciences has recently done a very proper thing. On the suggestion of the council, the Hon. Secretary was instructed to communicate with such members of the Society as might be elected to serve on the Perth School Board and other School Boards in Perthshire, and ask them to keep in view the importance of introducing into the course of instruction in schools the elements of natural science.

SOME time since a paragraph appeared in NATURE relating to a supposed power of a preparation of boxwood over the growth of the human hair. A correspondent would be glad if any of our readers could inform him in what way the preparation is made, and what part of the plant is used.

MR. F. W. PUTNAM has sent us a few archæological notes on an ancient fortification surrounded by a great number of mounds, at Merom and Hutsonsville, Sullivan Co., Ind., U.S. The fort is situated on a plateau of loess, about 170 feet above the Wabash, on the east bank of the river. The position of the fort would be one of great advantage even at the present day. One of the mounds outside was dug into, and at the bottom of the pit thus made were found remains of a fire, bones of animals, pottery, and an arrow head. Mr. Putnam concludes that the pits now filled up so as to form mounds, were the houses of the inhabitants or defenders of the fort.

THE additions to the Zoological Society's Gardens during the last week include an Ocelot (*Felis pardalis*), from Honduras, presented by Miss E. E. Brooks; two vinaceous Turtle Doves (*Turtur vinaceus*) from W. Africa, presented by T. P. Tindale; a Leopard (*Felis pardus*) and a Civet Cat (*Viverra civetta*) from W. Africa, presented by L. Hart; two Goldfinch (*Carduelis elegans*) and two Canary Finches (*Serinus canarius*) from Madeira, and a Paradise Whydah Bird (*Vidua paradisea*) from W. Africa, presented by Lieut. F. L. C. Hearne; a Philantomba Antelope (*Cephalopus maxwellii*), born in the Gardens; three Indian Tree Ducks (*Deudrocygna arcuata*); three Summer Ducks (*Aix sponsa*) from N. America; two Hooded Cranes (*Grus monachus*) from Japan, purchased; two Malayan Tapirs (*Tapirus indicus*), a Rhinoceros Hornbill (*Buceros rhinoceros*), from the Malay peninsula; a Derbian Wallaby (*Halmaturus derbianus*) from Australia; a Hoffmann's Sloth (*Cholopus hoffmanni*) from Panama; and a Greater Sulphur Crested Cockatoo (*Cacatua galerita*) from Australia, deposited.

THE BIRTH OF CHEMISTRY

IX.

Early Ideas concerning the Process of Combustion.—Association of Nitre with the Air, so far as the part they play in Combustion is concerned.—Hooke's Theory of Combustion. -Mayow's Experiments.—Early Pneumatic Chemistry.—Proof of the Analogy existing between Combustion and Respiration.

AS in the history of matter we find molecules grouping themselves around a common centre or a common line, thus constituting crystalline bodies, so in the history of sciences and of nations we may often observe well-defined axes, about which the facts of particular epochs congregate. Such axes are to be found in the history of chemistry. At the particular period of which we now write, the facts of the science mainly grouped themselves around theories connected with combustion, which involved as collateral matters conceptions regarding the nature of calcination, and of the air.

Combustion was, and still is, the most prominent exhibition of chemical force, with which man ordinarily comes into contact. It is a purely chemical action—the union of dissimilar bodies under the influence of chemical affinity, attended by the evolution of light and heat. Many attempts were made to explain its cause. Fire, in common with earth, air, and water, as we have before seen, was regarded as an element, till almost within our own memory. Epicurus regarded heat as a congeries of minute spherical particles possessing rapid motion, and readily insinuating themselves into the densest bodies. Fire was simply an intense form of heat. Cardanus speaks of flame as *aer accensus*, and of fire as heat immensely augmented. During the Middle Ages the existence of two kinds of fire was admitted—the one pure celestial fire "*subtilis ignis*," "*cœlestis ignis*," the principle or essence of fire; the other "gross earthly fire," or "mundane fire." The latter was the *materia*, the former the *forma*. Celestial fire became mundane fire when it was associated with combustible bodies, that is, in ordinary combustion. Seneca tells us that the Egyptians divided each element into an active and a passive form; fire became active flame which burns, and comparatively passive warmth and light. The elemental nature of fire was not universally admitted during the Middle Ages; thus Francis Bacon asserts, in the *Novum Organum*, that fire is "merely compounded of the conjunction of light and heat in any substance," and he defines heat as a rapid motion of material particles. Athanasius Kircher, in his ponderous treatise, "*Ars Magna Lucis et Umbræ*," affirms that fire is air which is caused to glow by the violent collision of bodies, by which means combustible bodies become flame. At an early date it was observed that fire cannot exist without air; the experiment of burning a candle in a closed vessel was well known. Some affirmed that "air is the food of fire," some that "air nourishes fire." The influence of a blast of air upon fire was well recognised; we have seen that bellows were known at a very early date. When nitre—which for many centuries was one of the most important bodies in chemistry—came to be known, it was soon noticed that it produces intense ignition; that, in fact, to direct a blast of air upon a red-hot coal, or to throw some nitre upon it, produced the same result, viz. greatly augmented combustion. Hence arose the idea that nitre and the air are in some way connected, for "things which are equal to the same are equal to each other." This association of ideas may seem crude to us now, yet we must remember that nitre produces rapid combustion simply because it contains a great quantity of that constituent of the air, oxygen gas, which ordinarily produces combustion. Thus the old natural philosophers, wandering in the dim twilight of experimental knowledge, were not so far wrong in their supposition. The idea mentioned above was very prevalent two centuries ago: Robert Boyle speaks of the presence of a "volatile nitre" in the air; Lord Bacon says that nitre contains a "volatile, crude, and windy spirit"; Clark attributed thunder and lightning to the presence of nitre in the air; Gassendi imagined that minute particles of nitre are diffused throughout the atmosphere. When we heat lead or tin in a current of air, these metals are respectively converted into a powder, or *calx*, and calcination was one of the most important processes in old chemistry. Calcination seemed to be due more or less directly to the air; and metals could also be calcined by heating them with nitre, or with the spirit of nitre—nitric acid; hence arose another bond of connection between nitre and the air; at least, they had something in common. Lemery in his "Cour de Chimie," published in 1675, affirms that the acid of nitre contains a number of "*corpuscules ignées*" locked up in it, and he defines these latter as "a subtle matter, which having been thrown into a very rapid motion, still retains the power of moving with impetuosity, even when it is enclosed in grosser matter; and when it finds some bodies which by their texture or figure are apt to be put into motion, it drives them about so strongly that, their parts rubbing violently against each other, heat is thereby produced."

Thus recognising the causes which had led to the association of the air with nitre, at least so far as they are both concerned in the production of combustion, we are prepared to examine Robert Hooke's theory of combustion. The announcement of this theory marks an important history in the theory of chemistry; it was the first chemical theory worthy of the name, and it gave a far more just and accurate explanation of combustion than the crude and over-belauded theory of Phlogiston, of Beccher and Stahl. Hooke's theory was, moreover, founded upon experiment, and although unfortunately he does not describe the experiments, we see at a glance that it could not have been constructed without such means. "This hypothesis," he writes, "I have endeavoured to raise from an infinity of observations and experiments," and all who know Hooke's writings, are well aware how good an experimenter he was. The theory was published in 1665 in Hooke's "*Micrographia*;" it is there found (Observation 16) buried in a mass of irrelevant matter, and to this cause may, perhaps, to some extent be attributed the fact that it has been so little recognised and known. The theory is stated in twelve propositions, the principal of which are as follows:—

1. That the air is the "universal dissolvent of all sulphureous bodies."

Sulphur was long regarded as the type of combustible bodies, on account of its ready inflammability; some even derive the name from *sal*, πῦρ, the salt of fire. By sulphureous bodies, Hooke simply meant combustible bodies, viz. bodies that can burn in a supporter of combustion. By air being the "universal dissolvent," he meant that through the agency of air combustible bodies are caused to become transformed into similarly invisible substances. For instance, we burn a pound of wood, and a few grains of ash remain, the rest has disappeared into air; as we say now, it has been converted into carbonic anhydride gas; as Hooke said then, it has been dissolved by the air.

2. "That this action it (the air) performs not until the body be sufficiently heated."

In more modern phraseology, every combustible possesses its special igniting point, phosphorus 92° F., sulphur 482° F., and so on.

3. "That this action of dissolution produces or generates a very great heat, and that which we call *Fire*."

4. "That this action is performed with so great a violence, and does so minutely act, and rapidly agitate the smallest parts of the combustible matter, that it produces in the diaphanous medium of the air the action, or pulse, of *Light*.

This would seem to indicate that Hooke considered light to be an intensified form of heat, and to be generated in the same manner, and to be a kind of very rapid motion.

5. "That the dissolution of sulphurous bodies is made by a substance inherent and mixed with the air, that is like, if not the very same with, that which is fixed in saltpetre."

Hooke had evidently traced the connection between certain actions produced by the air and by saltpetre or nitre; and he says it may be readily demonstrated that combustion is effected by that constituent of the air which is fixed in saltpetre. This is a remarkable assertion, because oxygen gas was not discovered until more than a century after the proposition of Hooke's theory; and we now know that nitre contains "fixed" in it the same substance—oxygen gas—which causes air to "dissolve" combustible bodies. It is probable that the connection between air and nitre may have been rendered the more probable in the minds of Hooke and his contemporaries by the knowledge that gunpowder will burn in a space devoid of air; thus, if sulphur and charcoal burn in air, and consume air in burning, and if nitre will cause them to burn out of contact with air it would surely appear that nitre must contain air, or one of its components.

10. "That the dissolving parts of the air are but few, ... whereas saltpetre is a menstruum, when melted and red hot, that abounds more with these dissolvent particles, and therefore as a small quantity of it will dissolve a great sulphureous body, so will the dissolution be very quick and violent."

It was well known that if a piece of red-hot charcoal be thrown into melted nitre, it is consumed with great rapidity, while in the air it burns with far less readiness; hence Hooke infers that that particular component of air which causes it to support combustion exists in a condensed form in saltpetre. He also remarks that if air be violently forced upon a piece of ignited charcoal by bellows it may be made to burn almost as rapidly as in melted nitre.

12. "It seems reasonable to think that there is no such thing as an *element of fire* . . . . but that that shining transient body called *flame* is nothing else but a mixture of air and volatile sulphureous parts of dissoluble or combustible bodies."

Hooke asserts that this theory had been worked out by him several years earlier, and had been well supported by experimental means; he says, moreover, that he has here "only time to hint an hypothesis, which, if God permit me life and opportunity, I may elsewhere prosecute, improve and publish." This he never did; but a young Oxford physician named John Mayow (b. 1645 d. 1679) eagerly accepted the theory, and adduced many experiments in support of it. Perhaps Mayow may have worked with Hooke, during his residence in Oxford, and may have helped to adduce verifications of the then half-formed theory. Mayow's experiments are contained in a treatise entitled—"*Tractatus Quinque Medico-Physici quorum primus agit de Sal-nitro et Spiritu Nitro-aëreo, Secundus de Respiratione* . . . . Oxonii, 1674." The book is altogether important, because the experiments which it contains form the basis of pneumatic chemistry, that is the chemistry of gaseous bodies; it is also distinguished by accurate reasoning and well-founded generalisations. Had it been better known, it can scarcely be doubted that the discovery of oxygen and of various gases made a century ago, would have been forestalled by many years.

FIG. 18.—John Mayow.
(From his "Tractatus Quinque Medico-Physici, 1674.")

Mayow calls the "dissolving parts" of the air and of nitre, which we now call oxygen gas, by the several names of *nitre air*, *fire-air*, and *nitro aërial spirit*. Air does not consist wholly of nitre-air, because when a candle is burnt in a closed vessel only a portion of the contained air is consumed Nitre-air exists in large quantities in a condensed form in nitre; hence combustible bodies mixed with nitre will burn under water, or in a vacuum. The acid of nitre contains all the nitre-air in nitre, but it does not inflame bodies so readily as nitre because in it the nitre-air is surrounded by particles of water which tend to quench the burning body. Nitre-air is not combustible itself, neither does nitre contain any combustible substance, because it may be fused in a red-hot crucible, but no ignition will be observed to take place, until a combustible body has been added. All acids contain nitre-air:—how curiously this contrasts with Lavoisier's name *oxygen*, from οξυς γενναω, which he gave to the gas, because he believed it to be an essential constituent of all acids. Sulphuric acid, according to Mayow, consists of nitre-air united with sulphur; wines become sour and are changed into vinegar by the absorption of nitre-air from the atmosphere. It is the cause also of fermentation and putrefaction, and for this reason, substances when covered with fat or oil do not putrefy. During calcination metals increase in weight, and this increase is attributed by Mayow to absorption of nitric air; thus calx of antimony is antimony *plus* nitre-air, and this is borne out by the fact that a substance absolutely similar to calx of antimony may be procured by treating the metal with the acid of nitre and evaporating. Again, rust of iron is iron united with nitre-air.

We come now to some of the first experiments in Pneumatic Chemistry. In one of his experiments Mayow supported a kind of ledge within a bell-jar full of air (see Fig. 19); upon the ledge he placed a piece of camphor, and fired it by concentrating the rays of the sun by a lens upon it. The camphor ignited and burnt for some time, water then rose in the jar; and on again attempting to ignite the camphor he was unsuccessful. A lighted candle was also burned in the jar with the same result. Thus a part only of the air had been consumed, and the remainder was unable to support combustion. The siphon tube (shown on the right-hand side of the figure) was inserted at the commencement in order to render the height of the water the same, inside and outside the tube, as stoppered air jars were then unknown.

Thus it was clearly proved that air is diminished in bulk by combustion. In order to prove that respiration produces a similar result, Mayow tied a piece of moist bladder over the mouth of a jar (Fig 20). and upon this he pressed a cupping-glass, so that the edges fitted air tight Within the cupping-glass he placed a mouse, and as the animal continued to breathe he noticed that the bladder was forced up, more and more into the cupping-glass, proving that the air within it had been diminished by the respiration. Thus Mayow endeavoured to establish a connection between combustion and respiration. He also placed a mouse in a vessel standing over water, and noticed that the water rose in the jar as the respiration continued; and he found it impossible to ignite a combustible body in a jar of air in which a mouse had died. Again, he placed a mouse and a lighted candle together in a jar of air, and he noticed that the mouse only lived half as long as a mouse lived in the same bulk of air without the candle. Air deprived of its nitre-air was assumed to be lighter than nitre-air, because if a mouse is placed near the top of a closed vessel, it dies sooner than if placed near the bottom.

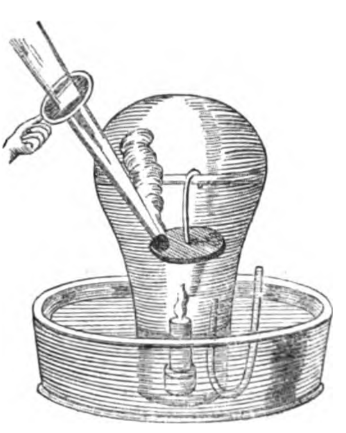

FIG. 19.

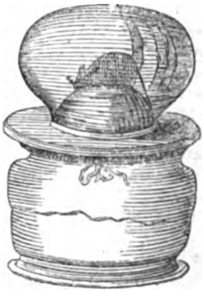

FIG. 20.

Fig. 19.—Early experiment in pneumatic chemistry. Fig. 20.—Early experiment in physiological chemistry.

In 1672 Robert Boyle procured hydrogen gas by acting upon iron filings with an acid, and proved its inflammability; but he does not appear to have further studied its properties, and its discovery is always attributed to Cavendish, a century later. Boyle suggests that it probably consists of "the volatile, sulphur of Mars, or of metalline steams participating in a sulphurous nature." Mayow also procured some of this gas by acting upon iron with dilute sulphuric acid, and he proves that it is not a supporter of life.

Mayow's second treatise is on respiration, and he herein expresses views far in advance of any of his predecessors. He proved that the nitre-air is alone concerned in respiration, and he asserts that this is absorbed by the blood, while the rest is rejected. It unites with combustible particles in the lungs, and thus produces animal heat. The lungs consist of a number of minute sack shaped membranes through which the nitre-air passes to the blood.

We add the following *résumé* of Mayow's treatise, and of the position which it ought to occupy in the history of chemistry, from an article which we wrote on the subject a few years ago.

Mayow's work is remarkable in several respects. In it he conclusively proved that respiration and combustion are analogous processes; he upset the four-element theory by demonstrating the compound nature of air; and he recognised oxygen and nitrogen as clearly and almost as notably as they were recognised a hundred years later—the one the supporter of life and combustion, the principle of acidity, and the cause of fermentation and putrefaction, heavier than atmospheric air; the other incapable of supporting life or combustion, and lighter than atmospheric air. We find, moreover, in this work the dawn of the idea of chemical affinity in the *fermentation*, which he speaks of as taking place between nitre-air and combustible particles, and extending to the production or destruction of things. Mayow even employs some of the terms in general use in the present day; thus he speaks of *affinitas*, existing between acids, and earthy substances, and uses the words *combinetur* and *combinentur* in speaking of the *congressus* of different substances.

The treatise is characterised by much clear and condensed thought, well-sustained argument, and accurate reasoning; moreover, we seldom meet with instances of too hasty generalisation, always the dominant source of error in the early development of a science. We further observe a great advance towards that exact and discriminative mode of thought which is necessary for the investigation of chemical phenomena. The period in which Mayow wrote, was, as regards chemistry, a period of transition; there was as yet no work on scientific chemistry, yet Mayow's treatise approached more nearly to such a work than that of any of his predecessors. The works of previous writers in this direction belonged to one of the three following classes: they were either chemico-metallurgic, chemico-medical, or alchemical treatises, or they partook of the nature of all three. The publication of works on alchemy was fast waning before the advances of the new philosophy; for as superstition retreated, and as men began to devote their energies to the legitimate investigation of nature, a false and chimerical art must of necessity cease to find votaries. Mayow was the first to discuss the intimate nature of an intangible body; other writers had treated of the air as a whole, but no one had endeavoured to ascertain the nature of its internal constitution, or to determine why it produces certain changes in surrounding bodies, upon what these changes depend, and the nature of the constituent or constituents of the air producing them. The old dogma of the elemental nature of the air was received as an absolute truth, although entirely unproven; it was thought that a theory which had been received since the earliest ages must of necessity be correct, and no attempt was made to disprove it.

We see from the above that it was the investigation of the nature of nitre which led to the knowledge of the constitution of the air, and to the first experiments in pneumatic chemistry. Mayow remarks at the commencement of his treatise, that so much had been written about nitre, that it would appear "*ut sal hoc admirabile non minus in philosophia, quam bello strepitus ederet; omniaque sonitu suo impleret;*" and when he remembers its connection with the foregoing results we are almost inclined to agree with him.

G. F. RODWELL

SCIENTIFIC SERIALS

THE *Journal of Botany* for April commences with two useful papers on Cornish botany: Supplementary Contributions to the Flora of North Cornwall, a very little known district, by Mr. J. G. Baker, and another by Mr. T. Archer Briggs.—Mr. F. E. Kitchener contributes a very interesting note on Cross-fertilisation, as aided by sensitive motion, in Musk and Achimenes, the former from observations of his own, the latter from those of Miss Dowson. The structure and motion of the sexual organs, which have long been known in both these flowers, are clearly shown to be contrivances for ensuring cross-fertilisation by insect-agency.—Dr. M'Nab, in a short paper, suggests the employment of the term "pseudocarp," to distinguish fruit-like structures from true fruits, such, for instance, as the apple, the strawberry, the rose-hip, the mulberry, and the fig, into the composition of which other organs besides the true fruit enter. Among the short notes, the most interesting is one of the discovery of *Echium plantagineum* in Cornwall, by M. Ralfs, the plant having been hitherto confined, as far as British botany is concerned, to the Channel Islands. There is a coloured illustration of four new Hymenomycetous fungi, by Mr. W. G. Smith.

Poggendorff's Annalen, No. 1, 1873.—This number opens with the fourth of a series of papers, by Oscar Emil Meyer, on the internal friction of gases; he shows that Poiseuille's law for droppable fluids is verified for gaseous transpiration through narrow pipes.—Dr. Hermann Herwig communicates an account of experiments made on the action of the induction spark in explosion of gaseous mixtures; this action varying with pressure and concentration in the mixture, and with the quantity of electricity passed.—An apparatus of physiological interest, termed the Physometer, is described by P. Hartwig. It is a refinement on Robert Boyle's idea for examining the action of the swimming bladder in fish. The fish, enclosed in a wire cage, is elevated or depressed at will in a vessel filled with water, while the changes of volume in the animal are indicated by the rise and fall of water in a thin tube connected with the vessel.—Dr. Pfeffer, in a paper on the decomposition of carbonic acid in plants by the different spectral rays, infers from his experiments that the curve representing the decomposition mainly corresponds with the curve of brightness.—This paper is followed by another on a similar subject, by E. Gerland. Among the remaining articles may be noted those on the Synaphy (or cohesion) of ethers, by Dr. Scholz, on the polarisation and colour of light reflected in the atmosphere, by E. Hagenbach, and on the electromotive force of very thin gaseous layers on metallic plates, by F. Kohlrausch.

No. 2 contains one of a series of papers, by Julius Thomsen, entitled *Thermo-chemische Untersuchungen*. In the present number he investigates the affinity of hydrogen to the metalloids, chlorine, bromine, and iodine.—Oscar Meyer also continues his series on internal friction of gases; giving a detailed account of two kinds of apparatus for estimating the influence of temperature on friction, and adding some valuable observations on the dynamical theory of gases.—Several new apparatuses are described in this number, Prof. Mayer, of Hoboken, explaining a method of observing the phases and wave-lengths of sound-vibrations in air, and also his acoustic pyrometer based on this method; while an improved deep-sea thermometer, a new form of siphon, and a photometer based on the perception of relief, are described by their several inventors.—A second paper on the physometer is also communicated by P. Hartwig, in which the physiological and other applications of the instrument are more fully discussed.—W. Feddersen contributes an account of a phenomenon which he proposes to call *thermo-diffusion*, and which occurs when two portions of gas are separated by a porous diaphragm, the opposite sides of which have different temperatures. A diffusion is observed which, unlike the ordinary diffusion, takes place when, on both sides of the diaphragm, there is the same gas with the same pressure.—Dr. Morton communicates a note on fluorescence, supplementary to Hagenbach's researches; and there are, in addition, a few notes from English and other sources.

Revue des Sciences Naturelles, Nos. 1-3, 1872.—This new quarterly journal, published at Montpellier, is another proof of the scientific activity which is now reviving in France. Like Lacage Duthier's *Archives de Zoologie*, this provincial review will we trust exhibit what Prof. Jourdain calls in one of these numbers "ces qualités éminemment françaises: la méthode, la rigueur et la clarté," combined with *Deutscher Fleiss und Unbefangenheit*, which though of late years less common in France may well be reclaimed as no alien virtues by the countrymen of Descartes, and Cuvier, and Laennec. The editor is M. Dubrueil, with whom Dr. Heckel was associated in the first two numbers. Among the contributors are the names of Antouard, Barthélemy, Boyer, Paul Gervais, Joly, Jourdain, Robin, Malinowsky. The first number opens with a paper by Prof. Joly, on the development of the Axolotl, illustrated with some good drawings. There follows a short communication on a new French mollusk (*Pisidia Dubrueuii*), an introductory lecture on botany, and an account of the geology of the neighbourhood of Montpellier. Perhaps the most important part of this and the subsequent numbers is a series of careful abstracts of French and foreign publications in zoology, botany and geology. The second number contains a botanical paper on certain Juncaceæ, by Duval-Jouve, with plates; a new classification of Mammalia, by Prof. Contejean (there is nothing very new in it: the chief novelties are definitely uniting the elephant with Rodentia, and separating the Pinnipedia from the other Carnivora to associate them with Sirenia and Cetacea); a description of diatoms found in the mixture of various corallines and algæ which is known in pharmacy as "Mousse de Corse" (*Corallina corsica*, "sea-moss"), by A. de Brébisson; and a short account with a plate of the remarkable Filaria discovered in chylous urine, by Wucherer and T. R. Lewis, and lately found in human blood by the latter observer. Among the abstracts of this number, by Prof. Jourdain, is an interesting review of the affinities of *Amphioxus* and the Tunicata from an anti-Kowelevskian point of view, by Prof. Jourdain, *àpropos* of Giard's *Etude* on the subject in the *Archives de Zoologie*. The third number, published last December, contains, among other articles, an important communication from M. Bavay on the development of a frog (*Hylodes Martinicensis*, Tschudi), observed in the island of Guadaloupe. Though it issues from the egg as a perfect anurous abranchiate Batrachian, it can be seen in the semi-transparent fœtal coverings to go through the tadpole stage, having a well-developed tail and small external gills, both of course functionless. We congratulate M. Dubreuil on his enterprise and success, and hope he will be able to maintain the high character of the first three numbers of his review. P. S.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, April 17.—Dr. Odling, F.R.S., president, in the chair.—Dr. Debus, F.R.S., delivered a lecture "On the Heat produced by Chemical Action." The speaker considered the relation existing between the chemical affinity of the metals and the amount of heat they develop during oxidation or combination with chlorine, iodine, &c., and also the various interesting conclusions which may be drawn from the thermic results obtained by the solution of salts, especially noticing that, in double decomposition taking place in solution, those compounds are always produced which develop the greatest amount of heat.

Geologists' Association.—Excursion to Banbury, April 14 and 15.—This, the first excursion of the season, was under the direction of Prof. Morris and Mr. T. Beesley, and was largely attended. After their arrival at Banbury, the members and their friends examined exposures of the Middle Lias Clays (zone of *A. capricornus*) and the marlstone in the immediate vicinity of the town. Subsequently the party proceeded southwards, visiting at Twyford a section of the Lower Middle Lias, and at King's Sutton an extensive exposure of the marlstone which is here worked for ironstone. Fossils, especially Brachiopoda, are numerous at this place, and abundant occupation was found for the hammers of the party. At Newbottle Prof. Morris described the physical geology of the district, and showed how the hills and valleys, the agriculture, the occupations of the people, and even the houses and churches of a district, depended upon its geological structure. In the evening the members were entertained at a conversazione in the Town Hall, Banbury. A very fine collection of the local fossils as well as of antiquities and other objects of interest, had been brought together by the exertions of Mr. Beesley, and a large assembly testified to the interest the visit of the Association had occasioned. During the evening Prof. Morris delivered a lecture in which he described generally the geology of Banbury, and enlarged upon the advantages of a study of the science. The route for the second day was a long one, and the party left Banbury early, and proceeded by Constitution Hill section of Upper Lias, Broughton Castle and Church, Tadmarton quarries of great oolite, and Camp, Bloxham Church, Comb Hill quarry in inferior oolite, and Adderbury ironstone quarries in marlstone and upper lias. The physical and stratigraphical geology was explained at the various stopping places, and many fossils were obtained at some of the sections. At Tadmarton Mr. Beesley had provided luncheon for the members and visitors, who, while assembled in an ancient British camp, were addressed by Prof. Morris, Mr Beesley, and Mr. Lobley. The association has, during the present session, paid visits of inspection to the British Museum, the Museum of the Royal College of Surgeons, and the Museum of Practical Geology, and lectures descriptive of portions of the collections have been delivered by W. Carruthers, F.R.S., Prof. Morris, F.G.S., Prof. Flower, F.R.S., and R. Etheridge, F.R.S.

DUBLIN

Royal Irish Academy, April 14.—Dr. Stokes, F.R.S., vice-president, in the chair.—Professor R. Ball, LL.D., read some Notes on Applied Mechanics, and the secretary read, for Mr. Donovan, a description of a Comparable Self-registering Hygrometer.

RIGA

Naturforscher Verein, Aug. 28, 1872.—Cand. Westermann described his visit to the Ilsingsee, in which is an island that periodically appears and disappears. It generally makes its appearance above water as the warm weather comes on, and the phenomenon is supposed to depend on the development in the peat at the bottom of marsh and coal gas, which is increased by the heat, and causes the masses of peat to float upwards towards the surface.

September 25.—Herr C. Berg gave a detailed report of Dr. Müller's work on the "Application of the Darwinian Theory to Flowers and Flower-frequenting Insects."

October 2.—Dr. Kersting exhibited some living young frogs, which had been from four to six weeks in the tadpole state. While some had already completed their development, others were still at various stages of transformation; one animal had all four legs, but still retained its long tail, while another was as yet only a biped. In proportion as the feet developed, the animal became all the more meagre, and at the same time the faster the tail disappeared.—Herr Thoms produced some pieces of the so-called sugar boxwood, an inferior kind of South American mahogany, in which a remarkable secretion of a white hard substance had been found. He found it of the following composition :—Ca O 33·24. PO_5 42·30. Organic matter 3·06. Water 21·40, which is expressed in the formula $2\,CaO + PO_5 + 4\,HO$. This is almost the same composition as that of the substance which gathers round the kidneys of the sturgeon.

October 16.—Prof. Kieseritzky gave a list of plants rarely met with in the province around Riga.—Dr. Bienert read a paper on the *Coniferæ*.

VIENNA

Geological Institute, March 5.—Dr. R. v. Drasche showed a mineral that was found in the environs of Plaben, near Budweis, in South Bohemia. The specimens show a white nucleus which consists of felspar, and contains in almost equal proportions lime, potass, and soda. This nucleus is surrounded by a perfectly homogeneous, pellucid green mineral, which sometimes enters in small veins into the felspathic substance; the microscopic examination of this green mineral shows not only the polyhedric forms of the metamorphosed feldspar, but even the stripes characterising the feldspar-twins (*Zwillings-streifung*) are clearly visible. There can be no doubt therefore that the green mineral is a real pseudo-morphosis of feldspar; it belongs to the family of the chlorites and in its properties and chemical constitution is most similar to the pennine or to the pseudophite, described by Kenngott from Mount Idiar in Moravia.—T. Posepny on tube-ores (*Kohren Erze*) from Raibl in Corinthia. In the lead mines of Laibl there are to be found stalks, some lines in diameter and some inches in length, consisting in the outer part out of crystalline galena, whilst the axis is either quite hollow, or is filled with earthy matter. These tubes are inclosed in the dolomite which is the bearer of the lead ores of the country. M. Posepny thinks that these tubes are formed by the deposit of the galena on real stalactites.—M. Ch. v. Hauer on the occurrence of different sorts of coal in one and the same bed. By an accurate investigation of the brown coal of different localities in Styria, the author stated that it consists generally of two different sorts of coal which are mechanically mixed in the same bed, and sometimes in every single specimen. The one sort shows a rather slaty fracture, is faint, compact, and of less heating power; the other, on the contrary, has a conchoidal fracture, is shining, more easily friable, of greater heating power, and may be coked. In the same way in some layers of lignite v. Hauer found small parties of shining coal which resembles good brown coal; he is inclined to suppose that such differences of the coal in the same bed may be caused by differences of the vegetables out of which the coal has been formed.

PHILADELPHIA

Academy of Natural Sciences, Oct. 1, 1872.—Prof. Leidy remarked that he had visited a corundum mine recently opened in the city of Unionville, Chester Co., Pa. The accumulation is perhaps the most extraordinary discovered, and its extent yet remains unknown. The corundum, as exposed to view at the bottom of a trench, appears as the crest of a large body or vein lying between a decomposing gneiss and a white talcose schist. The exposed portion averages about six feet in depth and five feet in thickness at bottom, and is estimated to contain about fifty tons. It looks as if it promised to be the most valuable deposit of corundum ever found. The corundum is the pure material, and is not emery.

October 8.—Mr. Thomas Meehan remarked, that as botanists well knew, *Quercus prinoides* seldom grew more than two feet in height. It was one of the smallest of shrubs. In his collections in Kansas, he found oaks in the vicinity of Leavenworth, which made small trees from ten to fifteen feet high, and with stems from one to two feet in circumference. He was entirely satisfied that it is identical in every respect but size with the *Q. prinoides* of the Eastern States. Among trees there are few which produce forms as low shrubs; but the *Pinus Banksiana*, in the East but a bush of five or ten feet, grew often forty feet along the shores of Lake Superior; the *Castanea pumila*, Chinquapin chestnut, when it gets out of the sands of New Jersey into the clayey soils west of the Delaware, often grew as large as many full-grown apple trees; while the *Celtis occidentalis*, which in the East is generally but a straggling bush along fence corners, is in Ohio a large spreading tree with enormous trunk, and in Indiana is as lofty and as graceful as an elm.

PARIS

Academy of Sciences, April 7.—M. Bertrand in the chair. The following papers were read:—On batteries and on electro-capillary actions, by M. Becquerel.—On a new method for the application of the third theorem to the control of geodetic lines and to the determination of the true figure of the earth, by M. Yvon Villarceau.—On the discovery of Lunar variation by Aboul Wefâ, by M. Chasles.—On an accessory reduction in the number of periods produced by juxtaposition at the moment of the formation of a double point, by M. Max Marie.—On Metallic Reflection, by M. Mascart.—On the action of electric currents on atmospheric air, by M. Boillot; a paper dealing with the formation of ozone by tubes coated with carbon powder.—Note on a new series of samples of crystalline or crystallised substances obtained in the dry way, by M. Ch. Feil.—A letter was received from M. Van der Mensbrugghe, stating that he had been completely convinced by the arguments and experiments of M. Gernez and Violette, in the recent controversy on crystallisation, and seeing that the superficial tension of liquids did not play the important part he assigned to it, he requested the Academy to consider his recent papers as not received.—A note on Tempel's comet (1867, II), was received from M. Stephan.—On composite electric sparks, by M. Gazin.—On the Phonoptometer, an instrument for the study of periodic or continued movement, by M. J. Lissajous.—Note on the effects produced by currents of electricity on mercury immersed in different solutions, by M. Th. du Moucel.—On the solvent action of glycerine on metallic oleates, calcic oleates, and calcic sulphate, by M. Asselin.—On the action of chloracetylic chloride on aniline and toluidine, by M. D. Tommasi.—On the toxic effects of the iodides tetramethylammonium, and tetramylammonium, by M. Rabuteau; the author has found that so long as an atom of hydrogen remains unreplaced, the amyl and methylammonium compounds are harmless, but that as soon as the last atom of hydrogen is replaced by the radicle, the body becomes excessively poisonous, with an action like that of curara.—On the age of elevation of Mount Lozère, by M. Fabre.—Note on the public fountains of Toulouse, by M. Grimaud de Caux. During the meeting an election to the vacant chair of the late M. Delaunay, in the astronomical section, took place. M. Loewy obtained 31, M. Wolf 24, and M. Stephan 2 votes; M. Loewy was declared elected.

April 14.—M. de Quatrefages, president, in the chair.—Explanation of the text of Aboul Wefâ on the third irregularity of the moon, by M. Chasles.—A long and detailed reply to M. Faye's late criticism on the solar spot theory was received from Father Secchi; this was followed by an answer by M. Faye, who also answered M. Vicaire's attempted revival of Herschel's theory in the same paper.—A correspondent for the astronomical section, in place of the late M. Quoy, was then elected, M. Mulsant obtained 31 votes, M. Baudelot 8, and M. Joly 1; M. Mulsant was therefore declared duly elected.—A report on M. Boussinesq's "Essay on the theory of running waters" was then read.—On the residues relative to Asymptotes, classification of the quadratics of algebraic curves, by M. Max Marie.—New observations on the theory of solar cyclones, by M. Vicaire.—A memoir on substitutions (mathematical), by M. C. Jordan.—On a new determination of the constant of attraction and of the mean density of the earth, by MM. A. Cornu and J. Baille.—On the effects produced by electric currents on mercury immersed in different solution, by M. Th. du Moucel, a continuation of the paper read at the last meeting.—On irradiation, by M. F. P. Le Roux.—On the hybrid reproduction of Echinoderms, by M. A. F. Marion.—On the trunk of a Nemertian hermaphrodite from the coasts of Marseilles, by M. E. Zeller.—A study on the carboniferous formations of the Bas Boulonnais, by MM. Gosselet and Bertaut.

DIARY

THURSDAY, April 24.

Royal Society, at 8.30.—On the Durability and Preservation of Iron Ships, and on Rivetted Joints Sir W. Fairbairn.—On the Employment of Meteorological Statistics in determining the best course for a Ship whose Sailing Qualities are known: F. Galton.

Royal Institution, at 3.—Light: Prof. Tyndall.

Gresham Lectures, at 7.—On Climate: E. S. Thompson.

FRIDAY, April 25.

Royal Institution, at 9.—Palæontological Evidence of Modification of Animal Forms: Prof. Flower.

Horticultural Society, at 3.—Lecture.

Quekett Club, at 8.

Gresham Lectures, at 7.—On Climate in Health and Disease: E. S. Thompson.

SATURDAY, April 26.

Gresham Lectures, at 7.—On Stimulants: E. S. Thompson.

Royal Institution, at 3.—Ozone: Prof Odling.

Royal Botanic Society, at 3 45.

Geologists' Association, at 8.—Excursion from Charing Cross (2.25) to Charlton.

MONDAY, April 28.

Geographical Society, at 8 30.—On the probable existence of unknown Lands within the Arctic Circle: Capt. Sherard Osborn, R N.

London Institution, at 4.—Elementary Botany: Prof. Bentley.

TUESDAY, April 29.

Zoological Society, at 8.30.—Anniversary.

Royal Institution, at 3.—Music of the Drama: Mr. Dannreuther.

Society of Arts, at 8.—On the British Settlements in West Africa: Governor Pope Hennessy.

WEDNESDAY, April 30.

London Institution, at 12.—Annual Meeting.

Society of Arts, at 8.—On the Condensed Milk Manufacture: L. P. Merriam.

Geological Society, at 8.—On the Permian Breccias and Boulder-beds of Armagh: Prof. Edward Hull.—Geological Notes upon Griqualand West: G. W. Stow.—On some Bivalve Entomostraca, chiefly Cypridinidæ, of the Carboniferous Formations: Prof. T. Rupert Jones.

THURSDAY, May 1.

Linnean Society, at 8.—On Cinchonas: J. E. Howard.

Chemical Society, at 8.—On Zirconia: J. B. Hannay.—On a new class of Explosives: Dr. Sprengel.

Royal Institution, at 2.—Annual Meeting.

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